Bulletins, from July 13, 1908 to September 28, 1908

ASSOCIATION'S COPY

OF THE Aerial Experiment Association

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Bulletin No. I Issued Monday, July 13 1908

ASSOCIATION COPY .

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN No. I ISSUED MONDAY , JULY 13, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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WORK OF THE AERIAL EXPERIMENT ASSOCIATION . As recorded in telegrams sent by members of the A.E.A.

To Charles T. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 17, 1908, 5 P.M .—The Aerial Experiment Association, which has its winter headquarters at Hammondsport, N.Y., is an association of experimenters who are working conjointly to promote the progress of aviation in America.

At present there are five members: Alexander Graham Bell, F. W. Baldwin, J.A.D. McCurdy, Glen H. Curtiss and Thomas Selfridge. Their object is the construction of a practical aerodrome, or flying-machine, driven through the air by its own motive power, and carrying a man.

In pursuance of this aim, the Association has already built two aerodromes.

No. 1. Selfridge's “Red Wing”, upon plans approved by Lieut. Selfridge, and

No. 2. Baldwin's “White Wing”, upon plans approved by Mr. F. W. Baldwin.

The tetrahedral aerodrome of Dr. A. Graham Bell will probably be No. 3, and then will follow Nos. 4 and 5, the aerodromes of Mr. Curtiss and Mr. McCurdy. It is expected that all these aerodromes will be built within the present year.

The two aerodromes that have already been completed have been wrongfully ascribed in the public press to Dr. Bell the Chairman of the Association. His aerodrome has not yet 4 been completed, and work will not be resumed upon it until June, when the headquarters of the Association will be removed to Baddeck, Nova Scotia, where Dr. Bell has his summer home.

The work on Dr. Bell's machine progressed last year at Baddeck to the point of constructing a large tetrahedral kite known as the “Cygnet”, which, on December 6th, 1907, successfully carried Lieut. Selfridge up into the air to a height of 168 feet over the waters of the Bras D' or Lake. At the conclusion of this experiment the “Cygnet” landed very gently upon the surface of the water, and floated there, quite un-injured by its experience in the air. It was subsequently wrecked by being towed at full speed through rough water by a powerful steam-boat. By that time the season had so far advanced in Baddeck that further experiments with Dr. Bell's structures had to be postponed until the opening of navigation in the present year.

In June the Baddeck experiments will be resumed by the Association, by the construction of another tetrahedral structure upon the general model of the “Cygnet”, and the attempt will then be made to convert the kite into an aerodrome by providing it with motive power.

The first aerodrome actually completed by the Association was Selfridge's “Red Wing”. This aerodrome made a successful flight of 319 feet over the ice on Lake Keuka, near Hammondsport, N.Y., on March 12th, 1908, in the presence of many witnesses. This experiment was somewhat remarkable, as 5 being the first successful public flight of a flying-machine in America, the earlier flights of the Wright Brothers at Dayton, Ohio, having been made in secret. The machine had been provided with sledge-runners, and glided over the ice for about 100 to 150 feet before it rose into the air. It then flew very steadily at a general elevation of from 10 to 20 feet above the surface of the ice, carrying Mr. F. W. Baldwin as aviator.

The newspapers very generally reported the aviator as Capt. Baldwin, the balloonist, but this is a different man. Mr. F. W. Baldwin is a young engineer, a graduate of Toronto University, and a grandson of the celebrated Robert Baldwin, one of the founders of the Dominion of Canada, and premier of Upper Canada before the Confederation. Mr. F. W. Baldwin is the same engineer who designed and constructed the tetrahedral tower of steel which stands on Dr. Bell's estate near Baddeck, Nova Scotia; and the new aerodrome now awaiting trial at Hammondsport has been designed by him.

Aerodrome No. 1, Selfridge's “Red Wing”, came to an untimely end on March 17th, 1908, by an accident which completely demolished the machine, although fortunately the aviator and the engine escaped uninjured. The Association then immediately began the construction of aerodrome No. 2, Baldwin's “White Wing”.

Both aerodromes have been constructed in the aerodrome shed of Mr. Glen H. Curtiss of Hammondsport, who acts charge of Mr. William F. Bedwin, Superintendent of Dr. Bell's Baddeck Laboratory. The engine employed was specially designed for the Association by Mr. Glen H. Curtiss, and was manufactured by the Curtiss Manufacturing Company of Hammondsport.

On May 13th, 1908, an attempt was made to fly the new aerodrome, No. 2, Baldwin's “White Wing”, at the race track near Hammondsport. The aerodrome had been provided with light wheels, like bicycle wheels, to enable it to run over the ground until sufficient headway had been gained to enable it to rise into the air. The race track, however, proved to be too narrow to enable it to be used for this purpose, as the ends of the wing-piece were not raised sufficiently from the ground to escape contact with the raised sides of the track. The attempt was therefore made to start the machine from the grass plot contained within the oval race track, but the attachment of the wheels proved to be too weak to stand the strain of running over rough ground, and broke before much headway had been gained. The damage was repaired next day. The machine has been placed at a higher elevation above the wheels, so that it is hoped that the next experiment may star from the race track itself, instead of from the grass lawn, as the smoother surface of the track will give a better chance for getting up the necessary initial speed.

(Signed) Graham Bell.

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To Charles F. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 17th, 1908, 8 P.M .— A preliminary trial was made this evening of the aerodrome "White Wing", designed by F. W. Baldwin, and constructed by the Aerial Experiment Association of which Dr. A. Graham Bell is Chairman. The aviator's seat was occupied by Lieut. Thomas Selfridge, U.S.A. The people of Hammondsport turned out in large numbers to witness the experiment. No attempt was made to rise into the air.

The machine had been provided with wheels, but steering gear was not attached to them, as it was thought that the aerial rudder would control the motion of the machine while on the ground. This proved insufficient for the purpose, however, for the machine could not be kept from running off the track to one side or the other. It was therefore decided to make a slight change in the attachment of the front wheel, and provide it with steering gear, so as to enable the operator to steer the machine on the race track for a distance long enough to gain sufficient speed to get into the air. No attempt will be made to fly until the operators are satisfied that they have the machine under full control on the ground.

(Signed) Graham Bell.

To Charles F. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 18th, 1908. 5 P.M .—The aerodrome “White Wing” made a short flight here to-day, carrying its 8 designer, F. W. Baldwin, to a height of about 10 feet. The pressure of the air on the elastic rear edge of the lower aeroplane caused it to foul the propeller, and the aerodrome was therefore brought down to the ground, after having traversed a distance of 93 yards. The damage will be easily repaired.

The new steering gear, attached to the front wheel, worked satisfactorily, so that there is now no difficulty in keeping the machine on the race track while running on the ground. The race track has been widened by ploughing up a portion of the adjoining field and smoothing it with a roller.

(Signed) Graham Bell.

To Charles F. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 19th, 1908, 6 P.M .—Lieut. Selfridge made two flights this afternoon in Baldwin's aerodrome, “White Wing”. In first experiment machine ran 210 feet in six and a half seconds, on race track, before leaving the ground, and made a flight of 100 feet in two seconds, at elevation of three feet, and ran 201 feet on rough ground after landing, without injury to running gear. The flight was impeded by loose guy wires catching in propeller, but no damage resulted. In second experiment the machine made a beautiful and steady flight of 240 feet, at an elevation of at least 20 feet in the air, but landed badly in a newly ploughed field. The aerodrome is uninjured, but the truck carrying the front wheel ploughed into the ground, and injured front wheel. The damage can be easily repaired. The members of the Aerial Experiment 9 Association are encouraged to believe that the engine has abundant power, and that the machine is under good control in the air, so that skill alone on the part of the aviator is all that is needed to accomplish much longer flights.

(Signed) Graham Bell.

To Charles T. Thompson, Supt. Associated Press, N. Y.

Hammondsport, N.Y., May 21, 1908 —G. H. Curtiss of the Curtiss Manufacturing Company made a flight of 339 yards (1017 feet) in two jumps in Baldwin's “White Wing” this afternoon at 6.47 P. M.

In the first jump he covered 205 yards then touched, rose immediately and flew 134 yards further when the flight ended on the edge of a ploughed field. The machine was in perfect control at all times, and was steered first to the right, and then to the left before landing. The 339 yards was covered in 19 seconds, or 37 miles per hour. A previous trial was made earlier in the day but resulted in no flight.

The motor is a duplicate of the one used by Curtiss when he made his record of a mile in 26 # seconds, 136.4 miles per hour. This is the world's record for a first attempt.

(Signed) Selfridge.

To Charles T. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 23, 1908 —J. A. D. McCurdy handled Baldwin's “White Wing” in her fifth flight to-day. 183 yards was covered in 10 # seconds at 35 miles an hour. The 10 maximum height was about 20 feet.

Quite a strong quartering wind was blowing which McCurdy did not correct for by his lateral controls, this being his first trial, which caused the machine to careen and strike her right wing first. She then turned turtle pivoting on the nose and finally rested on her top plane with engine and wheels in air. The center panel was so strongly built, however, that it remained intact, the engine staying fast in its bed. Neither operator nor engine were in the least injured. The machine itself was, however, quite badly damaged, and it will take a couple of weeks to complete repairs.

This flight was the fifth made by the “White Wing” which has now traveled a total of 674 yards in the air.

Baldwin 40 yards

Selfridge 112 “

Curtiss 339 “

McCurdy 183 “

Selfridge's “Red Wing” traveled with Baldwin a total of 147 yards which makes a grand total of 821 yards covered by the Aerial Experiment Association in seven flights since March 11, 1908, with absolutely no damage resulting to either operator, or the engine which was the same in both machines.

(Signed) Selfridge.

To Charles T. Thompson, Supt. Associated Press, N. Y.

Hammondsport, N.Y., June 19th, 1908 —Preliminary tests of running gear and surfaces were made to-day with aerodrome No. 3, Curtiss's “June Bug”, which extended so late into the evening that there was no time left to make a flight.

(Signed) Graham Bell.

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To Charles F. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., June 20, 1908 —An unsuccessful attempt was made this evening to raise the aerodrome “June Bug” into the air.

(Signed) Graham Bell.

To Charles F. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., June 21, 1908 —The Aerial Experiment Association aero drome No. 3, Curtiss's "June Bug", made three successful flights here this afternoon with Mr. G. H. Curtiss as aviator. The first flight was 456 feet at the rate of 28.1 miles per hour; the second was 417 feet at the rate of 31 and one half miles per hour; the third was 1266 feet at the rate of 34 and one half miles per hour. This last flight is the longest yet made in public in America, and is only Mr. Curtiss's fourth attempt.

(Signed) Graham Bell. (Note:—Copies of Associated Press Dispatches written by Lieut. T. Selfridge after June 21, 1908 have not been received in time for this Bulletin. A. G. B).

To Mr. A. Graham Bell, King Edward Hotel, Toronto.

Hammondsport, N.Y., June 25, 1908 —"June Bug" made record flight early this morning, 725 yards at an elevation of forty feet. Time 41 seconds. Wind 8 to 10 miles an hour blowing with machine. Tips worked beautifully and machine under perfect lateral control; front rudder inefficient, hence descent. 12 Surfaces have been revarnished and colored yellow stretching them tight and absolutely air proof. Nothing materially injured. Will try again this evening.

(Signed) J.A.D. McCurdy.

To Alexander Graham Bell, Prescott, Ont., or Kingston, care of steam-boat Toronto of R. O. Steam-boat Line, which left Toronto to-day at two P.M. for Montreal, and if too late to catch boat repeat to Windsor Hotel, Montreal, Que.

Hammondsport, N.Y., June 25, 1908 —Curtiss flew eleven hundred and forty yards, three thousand four hundred and twenty feet in sixty seconds this evening about 7.30. We have telegraphed and telephoned Secretary Aero Club of America that we are now ready to try for the Scientific American Cup. Hurrah!

(Signed) Selfridge.

To Dr. A.G. Bell, Victoria Hotel, Charlottetown, P.E.I.

Hammondsport, N.Y., July 2, 1908 —All arrangements made with Aero Club for trophy trials on July fourth at Hammondsport.

(Signed) J.A.D. McCurdy.

To Dr. A.G. Bell, Victoria Hotel, Charlottetown, P.E.I.

Hammondsport, N.Y., July 3, 1908. —Flew three quarters of mile to-night. Everything O.K. for July fourth.

(Signed) J.A.D. McCurdy.

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To Dr. A. Graham Bell, Victoria Hotel, Charlottetown, P.E.I.

Hammondsport, N.Y., July 4, 1908 —Captured trophy to-day by flying distance of one mile in one minute and forty-two seconds. Flew full distance of valley. Came down on account of trees making beautiful landing. Machine under perfect control and everybody happy.

(Signed) J.A.D. McCurdy.

To Mauro, Cameron & Lewis, Solicitors of Patents, Washington, D. C.

Charlottetown, P.E.I., July 5, 1908 —Please send some one to Hammondsport, N.Y. at once at my expense to examine the aerodrome of the Aerial Experiment Association which has just won the Scientific American Trophy for heavier-than-air machines. We want to know what patentable features there may be about the machine. See Mr. Curtiss and report by mail to me at Baddeck, Nova Scotia. Take Lackawana or Erie train to Bath; local from there to Hammondsport.

(Signed) Graham Bell.

To G.H. Curtiss, Hammondsport, N. Y.

Charlottetown, P.E.I. July 5, 1908 —I have telegraphed Mauro, Cameron and Lewis of Washington to send patent expert to Hammondsport to examine “June Bug” and report to me what patentable features there may be about machine. Ask members of Association to give him every assistance. Accept our heartiest congratulations upon your magnificent success.

(Signed) Graham Bell.

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To J.A.D. McCurdy, Hammondsport, N.Y.

Charlottetown, P.E.I., July 5, 1908 —Thanks for telegrams. I recommend postponing further experiments until machine has been examined by patent expert. Important to keep machine uninjured until then. Just off for Baddeck.

(Signed Graham Bell.

To Aerial Experiment Association, Hammondsport, N.Y.

Pictou, N.S., July 6, 1908 —If McCurdy wishes to follow on line of “June Bug”, I recommend that McCurdy's machine be now built at Hammondsport and headquarters be retained there for the present. In meantime don't run any risk of injuring “June Bug” until an application for a patent has been prepared. Would like Baldwin to help me in Baddeck soon as possible, and when we are ready for motor would like all to come to Baddeck. If these plans are acceptable would simply let it be known that at my request further trials of “June Bug” will be postponed until another aerodrome has been completed so that in case of accident to one machine another will be available for experiments. Would say nothing about patents outside as this would only stir up other inventors to forestall us in the patent office. Telegraph reply to Baddeck.

(Signed) Graham Bell.

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To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., July 7, 1908 —Meeting held on receipt of telegram. Decided to follow your suggestion, which was in accordance with McCurdy's decision. Casey and wife start North in a day or so.

(Signed) T. Selfridge.

To Aerial Experiment Association, Hammondsport, N.Y.

Baddeck, N.S., July 7, 1908 —Thanks for telegram. Please write and telegraph Mauro, Cameron and Lewis, Washington, D.C. to send representative to Hammondsport if he has not yet appe ?? ar ed, and request representative to prepare an application for a patent at my expense. I will confirm matter by letter from here. Baldwin should not leave Hammondsport until he has given the patent expert what information he may desire concerning machines made in Hammondsport. First Bulletin of Association will be issued from here, Monday July 13, giving you full information as to what we are doing here. Please ask each member to write to me full account of what he is doing in Hammondsport, the information to be incorporated in succeeding Bulletins to be issued every week. In this way we can keep in touch with one another and incidentally secure written records of thoughts, ideas, and work done. Trouble will be saved here by sending six copies of any drawings or photographs illustrating letters.

(Signed) Graham Bell.

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LIST OF PAPERS PRESENTED MAY 17, 1908 .

The following papers were read at a meeting of the Aerial Experiment Association held at the headquarters in Hammondsport, N.Y., May 17, 1908:—

1. Description of Aerodrome No. 1, Selfridge's “Red Wing” F.W. Baldwin.

2. Description of Aerodrome No. 2, Baldwin's “White Wing” F.W. Baldwin.

3. Plans for an improved motor for flying machines G. H. Curtiss.

4. A brief sketch of the progress of the Art of Aviation T. Selfridge.

5. A query concerning the nature of the torque produced by twin propellers rotating in the same direction J.A.D. McCurdy.

6. Some thoughts concerning the effects of atmospheric pressure upon aeroplanes A.G. Bell.

7. Suggestions regarding the construction of light motors for use in flying machines A.G. Bell.

Papers 1,2, and 4 will appear in subsequent Bulletins. Nos. 3,5,6, and 7 appear in the present issue. A.G.B.

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PLANS FOR AN IMPROVED MOTOR FOR FLYING MACHINES: by G.H. Curtiss.

(Read May 17, 1908).

While extremely light motors may not be absolutely necessary in order to make a successful heavier-than-air machine, it stands to reason that a light motor of equal strength and reliability would be of great advantage. Other parts of the flying machine could be made heavier or could carry more load in the shape of freight or fuel.

The motors made by the Curtiss Company up to date have been the outgrowth of the cycle motor, and while they give as great power per pound weight as any motors which are now built for the trade, a much lighter motor of equal power can be built.

In designing such a new motor, we may consider first the system of cooling the cylinders. For aeronautical purposes, it is evident that the air cooled engine has many advantages. The weight of the water and radiators alone is objectionable, then there is danger of leakage where light construction is used. It would be impracticable to carry a large supply of water where if air could be utilized, a supply is always at hand. I am satisfied that cylinders up to 3 # inches in diameter can be satisfactorily cooled with air. the power of the engine is therefore limited only to the number of cylinders.

The type of multi-cylinder generally adopted is that of our eight cylinder engine which consists of two sets of four cylinders on the sane case at an angle of 90 degrees. 18 This construction gives perfect balance and good results generally. There is only one form in which anywhere near as many cylinders can be assembled with as little crank-case and shaft weight, and that is placing the cylinders in the form of a star with all the connecting rods attached to a single crank. With this construction, both the crank-shaft and crank-pin can be run upon roller bearings which will add about ten per cent to the power of the engine, and do away with three-fourths of the crank-case and crank-shaft weight found in the eight cylinder “V” type.

The two disadvantages of this type of engine are the difficulty of operating valves and lubricating the cylinders and bearings. The latter may be managed by forcing the oil through the shaft and connecting rods and feeding direct to each cylinder. Naturally the cylinder, or cylinders pointing down would get too much oil. While there is practically no way of preventing this, the trouble of fouling the plugs may be prevented by placing them in the sides of the cylinder and the exhaust valve in the end. The surplus oil which goes in these cylinders would then be blown out with the exhaust. The placing of the valves in the head would also help out greatly in the cooling of the cylinders, and a blast of air blown across-wise would keep them sufficiently cool to allow its being run continually. The overheating of the exhaust valve can be prevented by using the same valve on the intake stroke, the inrushing gas keeping it cool.

I believe that we can build a 35 horse-power engine of seven cylinders 3 ½ × 4 placed at equal distances apart around a crank, each cylinder fitted with a single valve in 19 the head; the gasoline being fed mechanically to each cylinder, at a weight of approximately 75 pounds, and would stand up and give full power for ten hours running.

The following sketch shows the general design of such a motor. The explosions take place in rotation as follows:— 1-3-5-7-2-4-6, making perfect balance and constant torque.

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A QUERY CONCERNING THE NATURE OF THE TORQUE PRODUCED BY TWIN PROPELLERS ROTATING IN THE SAME DIRECTION: by J.A.D. McCurdy.

(Read May 17, 1908).

Through the agency of the "Proceedings of the A.E.A." I would like to present a few thoughts concerning the torque produced in an aeroplane by the action of its propeller, or propellers and to enquire if there is perhaps a corellation between the action of double propellers rotating in the same direction, and the action produced in a kite composed of tetrahedral cells when struck diagonally by a gust of wind.

It is quite evident that a single propeller driven direct produces a torque and tends to revolve the machine in the opposite direction to which the propeller turns.

This torque may or may not affect the steadiness of the machine while in flight, but it is certain that if the torque were zero one of the elements which tend to tip the machine laterally would be eliminated.

Now let us consider the action of two propellers rotating in oposite directions but in the same plane. By analyzing the forces produced by the torque of these propellers and by taking moments of these four forces about the axis of the machine, we find that the resultant is zero, hence no resultant torque is produced in the aeroplane.

Now let us consider the third case of the two propellers rotating in the same plane, but in the same direction. If there were no resultant torque produced in this case, we can readily see the advantage of using this combination for 22 trasmition would be reduced to a minimum. By assuming a few arbitrary figures and applying them to a graphical diagram we can perhaps see the reasoning more clearly.

Let us choose 8 ft. propellers centered 10 ft. apart. Suppose for simplicity that the torque produced by each propeller is 240 foot pounds. That we could represent by 30 lbs., acting at the circumference of the blades. This gives us two sets of forces which we can combine into two separate couples.

The magnitude of one couple would be 30 × 18 = 540 ft. lbs., acting negatively. The magnitude of the other couple would be 30 × 2 = 60 ft. lbs., acting positively. By taking the difference of these two couples, we obtain a resultant of 540-60 = 480 ft. lbs., acting negatively, or in the direction opposite to the motion of the hands of a watch. This means that a resultant torque is produced in the aeroplane having a magnitude of 480 ft. lbs., acting positively.

Now is the reasoning employed here applicable to the condition existing in a tetrahedral kite when struck by a diagonal gust of wind, supposing the cells to be miniature propellers rotating in the same direction? If so would there not be a tendency to upset?

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J. O. D McCurdy May17 1908 W.F.B.

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SOME THOUGHTS CONCERNING THE EFFECTS OF ATMOSPHERIC PRESSURE UPON AEROPLANES: by Alexander Graham Bell.

(Read May 17, 1908)

In considering the action of moving air upon the surfaces of inclined aeroplanes, we should not lose sight of the fact that air exerts a statical pressure, due to the weight of the atmosphere as well as a dynamical pressure due to its own motion.

Calculation shows that a very slight diminution of atmospheric pressure on the upper surface of an aeroplane, or a very slight increase of static pressure on the under surface, would cause a lifting force to be exerted on the aeroplane equalling, if not exceeding the lift produced by a violent wind. This fact has so important a bearing on the theory of the aeroplane that it may be well to elaborate the point.

The weight of the atmosphere exerts a pressure of about fifteen pounds upon every square inch of surface; or, in other words, atmospheric pressure exerts, upon an aeroplane a pressure of about 2160 pounds per square foot of surface.

We are apt to ignore this pressure, enormous as it is, because when an aeroplane is at rest, atmospheric pressure on the upper surface is balanced by an equal pressure from below.

The case, however, is materially different when the aeroplane moves forward or when the wind blows upon the under 25 surface of an inclined aeroplane, for the air is then condensed below and rarefied above, so that the equilibrium of statical pressure is disturbed.

I shall not attempt to discuss the extent to which the equilibrium is disturbed, or whether the effect extends over the whole of both surfaces of the aeroplane, or only over parts of them. I shall simply show that a very slight disturbance in the equilibrium of statical pressure will materially affect the lift.

The atmosphere presses downwards upon the aeroplane with a force of 2160 pounds upon every square foot of surface. It also presses upwards with an equal force. If then, the atmospheric pressure acting upon the upper surface should be reduced by only 1/2160th part, the pressure on the under surface remaining unchanged, a lift would be produced equivalent to one pound per square foot of surface.

How slight a change of atmospheric pressure this means will be appreciated when we try to measure it by the movement of a mercury column. At normal pressure, the mercury stands at a height of about 30 inches. The rarefaction then required to produce a lift of one pound per square foot, would cause the mercury to fall 1/2160th of 30 inches, or 1/72 of an inch, an amount too small to be readily perceived: But if we assume that the statical pressure is increased below the aeroplane as well as diminished above, and to an equal extent, the movement of the mercury column would only be one half of the above amount. That is:— In order to produce a lift of one pound per square foot, the rarefaction above the aeroplane would be represented 26 by a fall in the height of the mercury column of 1/144 th of an inch, and the condensation below, by a rise of equal amount.

Thus, a difference of atmospheric pressure on the two sides of an aeroplane of so slight an amount as to be practically imperceptible when measured by a mercury column would result in an unbalanced statical pressure upon the aeroplane of the same order of magnitude as the dynamical pressures with which we are accustomed to deal. From this I draw the conclusion that all theories of aeroplane action that ignore the effects of atmospheric pressure must be grossly in error.

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SUGGESTIONS REGARDING THE CONSTRUCTION ION OF LIGHT MOTORS FOR USE IN FLYING MACHINES: by Alexander Graham Bell.

(Read May 17, 1908)

An arch of bricks quite strong enough to carry a railroad train, if turned upside down an s d supported by its two extremities would probably break in pieces from its own weight, for under such circumstances its resisting power would depend upon the cohesive strength of the mortar employed, and not upon the strength of the bricks. In its normal position the character of the cementing material is of comparatively slight importance and the bricks might even hold together without any mortar at all.

In a similar manner a hollow cylinder of any material is better adapted to withstand a pressure from without than from within on account of its circular or arched cross-section. A compressional force applied from without tends to push the parts of the cylinder more firmly together; whereas a bursting pressure from within tends to separate the parts from one another and they are only kept in place by the force of cohesion which cements them together. External pressure thus tends to bring into play the full resisting strength of the material of the cylinder, the strength of the elemental “bricks”, so to speak, of which it is composed;whereas internal pressures are only resi s ted by the “mortar”.

A cylinder composed of material just strong enough and no more, to resi ? s t the crushing effect of the atmosphere 28 when all the air is removed from within, would evidently burst under an internal pressure of one atmosphere. In order to resist such a strain from within it would be necessary to strengthen the walls of the retaining chambers by using thicker and therefore heavier ma e t erial.

Now lightness of construction is a great desideratum in a motor intended for use in a flying machine; and the above consideration suggests the thought that a motor utilizing atmospheric pressure as a motive power could be constructed of thinner and lighter material than would be possible in the case of a motor employing the expansive power of a confined gas. So far as power is concerned it matters not whether the operative pressure comes from without or within, for in both cases the operative power depends simply upon the difference between the external and internal pressures. So far as weight is concerned, however, it makes all the difference in the world.

Some objections of course immediately obtrude themselves, but I do not think they are insuperable by any means: In utilizing atmospheric pressure as a motive power we are limited to a single atmosphere of pressure, whereas we may have two or more atmospheres of pressure within our cylinder if we make it strong enough to resist the strain. Through the expansive power of a confined gas we can certainly obtain greater intensity of action than would be possible where atmospheric pressure is employed.

Perhaps, however, two cylinders each operating under a single atmosphere of pressure may be able to do the work of one 29 cylinder at two atmospheres, an d quantity may be made the equivalent of intensity.

Here the question arises: Can the two weaker cylinders be made to weigh less than the single, stronger cylinder required to stand the greater strain? I think there can be no doubt about it.

A cylinder, to resist a bursting pressure of one atmosphere, must evidently be made of heavier material than one calculated to resist the same strain from without; and its strength, and therefore weight, must probably be double d to enable it to resist a two-fold strain. If this is so the thicker and stronger cylinder will weigh more than both of the weaker cylinders combined.

Where we reduce the weight of an engine to the minimum consistent with the proper exhib i tion of power accidents are also always also liable to arise, because we approach the limit of strength of the material employed. Excessive internal pressure may cause the cylinder to explode, but excessive atmospheric pressure would only crush it in without any risk of injury to the aviator.

I commend this whole subject to the serious attention of Mr. G. H. Curtiss, as opening up a promising line of enquiry that may lead to the discovery of a lighter and safer motor than has hitherto been produced for use in flying machines.

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WORK OF BEINN BHREAGH LABORATORY. Report by Wm. F. Bedwin, Supt.

Laboratory opened May 25, 1908. First work started was to repair the old empty Frost-King kite, and also repair the Ring-Kite made last year. A photograph of the latter is shown on p. 33.

The stock for racing hulls for the new catamaran structure arrived on June 6, and on June 8 we laid the first keel. The two hulls are now nearly ready to be connected together with deck for support of the launching device. Both hulls are now in the condition of the one shown in the photograph on p. 32.

We have finished assembling a bank of 1992 winged cells ready for incorporation into the new tetrahedral aerodrome Size 60 cells on top, 8 cells high, and 8 cells deep. the uppper photograph on p. 33 shows this bank of cells upside down on the floor of the aer o drome shed in the position in which it was put together.

We have made three kites of tetrahedral construction which are now completed and ready to fly. Two are duplicates of kites used in Hammondsport; and the third is of similar shape and size, but made in three sections so as to have a hollow interior. Photographs of these kites, A,B,C, are shown on pp 34, 35, 36.

Kite A p. 34, of full c t etrahedral construction contains 408 winged cells.

Weight 9036 gms.

Surface 22 sq. m (Oblique)

Ratio 411 gms. per sq. m (Oblique).

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Kite B p. 35, of skeleton construction, contains 253 winged cells, and 155 empty cells.

Weight 8576 gms.

Surface 13.7 sq. m (oblique).

Ratio 626 gms. per sq. m (oblique).

Kite C, p. 36, of sectional construction contains 340 winged cells.

Weight 8766 gms.

Surface 18.4 sq. m (oblique).

Ratio 476 gms. per sq. m (oblique).

We have under construction and about three-fourths completed, 100 triangles, each having a side of 50 cm., to be assembled in pairs to make 50 cm. cells. These are covered with nainsook stretched tightly and cemented to frames with gutta-percha tissue. The frames are similar to those used in the triangular gliding models employed in the kite house last ye aa ar .

Stock on hand : We have laid in good stock of Cygnet beading; also of aluminum in the form of tubing, sheets, bars, and wires. We have now on hand 12300 empty tetrahedral cells and 2200 winged cells made here during the past winter, besides 5000 winged cells left over from last year.

Taken 1908 July 8 th SMD Dec 1908 July 8 SMD

34

KITE A.

35

KITE B.

36

KITE C.

37

TRIAL OF THE RING-KITE. July 7, 1908.

The Ring-Kite shown in photograph on p. 33 was tried on Tuesday July 7, flown by line attached to the front edge of the lower aeroplane. What little wind there was came from about N.E., blowing down the mountain towards the Bay, maximum velocity estimated at about 5 miles an hour. This wind was sufficient to support the kite in the air although the point of attachment of the flying-line was as far forward as possible; and the kite seemed to fly very steadily.

The point of attachment was then shifted successively further back towards the rear edge of the front aeroplane. The kite then flew at a greater elevation, but developed a tendency to slide to one side off the wind. Whether this was due to the fact that horizontal surfaces were alone employed, or to a slight distortion of the kite produced by the breaking of a few cell-sticks is not yet certainly known.

The upper and lower aeroplane rings had been rather heavily beaded on their outer and inner edges, but no beading had been provided extending from the lower to the upper aroplane, so that breaking strains upon landing were resisted only by the l g?th ight cell-sticks.

In order to enable the above experiment to be made a few stout sticks were fastened in front where the flying-line was attached connecting the lower and upper surfaces, and a short keel stick was added, so that the kite was somewhat head-heavy.

38

Upon landing after the first experiment a few cell-sticks were broken on one side where the superposed aeroplanes were not connected by beading. The subsequent trials were made without repairing this damage, although there was a visible distortion of the kite.

RING-KITE .

Weight 8626 gms.

Surface 11 sq. m (horizontal).

Ratio 784 gms. per sq. m (horizontal).

The photograph on p. 39, made by Mr. Grosvenor shows the Ring-Kite in the air. A.G.B.

14. Taken 1908 July Dev. 1908 July 8th S.M.D

BULLETINS OF THE Aerial Experiment Association

Bulletin No. II Issued Monday, July 20, 1908

ASSOCIATION'S COPY .

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN No. 2 ISSUED MONDAY , JULY 20, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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A BRIEF SKETCH OF THE PROGRESS OF THE ART OF AVIATION:— by Thomas Selfridge.

(A paper submitted by T. Selfridge, 1st. Lieutenant, 1st. U.S. Field Artillery, to the Aerial Experiment Association, May 17, 1908, with an account of the Association's experiments with their own machine, Aerodrome No. 2, subsequent to that date, revised for this Bulletin).

It was my intention, on starting this paper, merely to refer to those men who had actually been in the air in a dynamic flying machine. But I found on commencing that so much reference had continually to be made to the work of those men who actually laid the foundation for all that is now taking place, that I decided to go back to the beginning and sketch very briefly the whole subject.

The amount of thought, time, energy and money that has been expended is stupendous. I have only attempted to name the most prominent of those who have discovered and laid down the fundamental principles and laws upon which we are all now basing our experiments; and a few of the others, who, profiting by the work of the former, have actually made authentic flights.

It is an almost absolute fact that all men of any scientific attainments since the 14th Century, and even previous to that time, have dabbled in this fascinating subject, and hosts of others have tried to imitate the flight of birds since first those creatures were ? s een in the air by man.

A few of the earlier and best known scientists whom we see continually referred to by the authorities, are Newton, 4 who probably did more harm than good through the erroneous hypothesis upon which he based his calculations; Robert Hook, and Sir Christopher Wrenn, working as members of the Royal Society of Great Britain, and Hutton. Of comparatively recent date is the work of Dines, Duchemin, Von Loessel, Smeaton, and Langley; while among those now actively engaged in the work are found Prof. A.F. Zahm, of the Catholic University of Washington, D.C.; Wood of Johns Hopkins; Todd of Amherst; Durand of Cornell; Octave Chanute of Chicago; A. G. Bell of Telephone and Graphophone fame, and James Means of Boston, Editor of the Aeronautical Annual.

We may divide the progress of Aviation into the following periods:—

1st. The Ancient or Semi-Legendary ending with the 16th Century.

Danaeus, Oliver of Malmesbury, Dante, etc.

2nd. The earl y Scientific, ending with the 18th Century.

Da Vinci, Hooke, Wrenn, etc.

3rd. The early Experimental, dealing largely with small models to 1890.

Stringfellow, Tatin, Penand, Goupil, Hargrave, etc.

4th The later Scientific, or early practical machine from 1888 to 1893.

a. The sientific researches of Maxim, Langley, Tatin, Phillips, Goupil, Penand, Renard, Zahm etc.

b. The practical motorless glider of Lilienthal, Herring, Pilcher, Chanute, and the Wrights.

c. The practical motor-driven machines, of Phillips, Maxim, He e rring, Langley, etc.

5th. The present or the later practical motor-driven beginning at 1903.

Wrights, Farman, Aerial Experiment Association, Herring, etc.

5

The first authentic account we have of a man having actually traveled in the air for some distance with the aid of wings, and alighting without killing himself, is that of Oliver of Malmesbury, a Benedictine Monk, who, in the Eleventh Century, flew from the top of a tower against the wind, by the aid of wings, and alighted 125 paces distance. He fell, however, and injured himself badly. (See Chanute's Progress in Flying Machines, p. 78).

The next man to have fitted himself with wings and flown is J.B. Dante, a mathematician of Perugia, Italy. Toward the end of the 14th Century, he constructed a pair of artificial wings with the aid of which he glided over Lake Trasimene. An attempt was made to repeat this experiment at a wedding festival which took place in Perugia, by starting from the top of the highest tower in town and sailing across the public square. He is said to have stayed in the air for quite an appreciable length of time, but an iron forging which held one of his wings broke, and he fell on a church, breaking one of his legs. This terminated his earial experiments. (See Chanute's Progress in Flying m M achines, pp. 81, 82, 108, 208, 263).

The first scientist of note, of whom we have any authentic record, to devote much of his energies to the subject was Leonardo da Vinci who made copius notes on bird and man flight, as a result of keen observation of the former; and who, in 1500, designed a machine to be operated by man power, so arranged that the man could utilize almost every muscle in his body. He experimented extensively with paper screws which he was able to drive upward into the air, and among 6 his notes are found designs of one of 96 feet in diameter, made of iron and bamboo, and intended to lift a man. (See Chanute's Progress of Flying Machines pp. 11, 12, 49).

In 1569 we find that Paul Guidotti, an d artist of Luccia, Italy, constructed wings of whalebone, covered with feathers, and used them several times with success. He then attempted a flight from an elevation and sustained himself in the air for about a quarter of a mile, but, becoming fatigued, lost control and fell on a roof, breaking one of his legs. (See Chanute's Progress of Flying Machines, pp. 82, 208).

The Royal Society of Great Britain, in the 17th Century, gave out among its members various portions of the problem dealing with the art of flying, papers, upon which were later submitted and read before the Society, and may now be found among its proceedings. Some of the ablest of these were submitted by Robert Hooke and Sir Christopher Wrenn.

In 1678 a French Locksmith by the name of Besnier constructed a pair of oscillating wings hinged at the shoulders and worked by his hands and feet. The wings were arranged like folding shutters. He did not pretend to be able to rise or fly horizontally, but was able finally after much practice to glide considerable distances when starting from high places. (See Chanute's Progress of Flying Machines, pp. 12, 13).

All the flights mentioned so far were really what would now be called glides.

We next come to the work of the second period, or that of more recent investigators to whom we owe much of the 7 data upon which we base our present experiments. In 1784 Kaunnoy and Bienvenu of France built a model of superposed screws driven by a bow, and submitted it to the French Academy of Sciences. This flew successfully and they drew up plans for a larger man-carrying machine which, however, was never completed. (See Chanu c t e's Progress of Flying Machines, pp. 50, 55).

In 1842 H.F. Phillips of England constructed his first aerial machine driven by a Hero motor. He exhibited a model of it in 1868. He was the first man to investigate thoroughly the effects of curvature on the lift of various surfaces, and in 1884 patented a large series of curved shapes. Continuing he patented in 1891 what he considered the most efficient form of all. In 1890 he patented a machine resembling very closely a venetian blind, placed above a body designed to carry the engine and aviator. He is still at work on a modified form of this machine. The surfaces are very thin shallow planes of considerable extent constructed of wood and having the curvature of the form patented by him in 1891. He successfully drove this machine on a circular track from which it rose while confined by a cord o t o a pole in the center. (See Chanute's Progress of Flying Machines, pp. 50, 62, 157, 166, 172, 202, 218, 226, 254).

In 1851 Le Bris, a French sea captain, designed a machine to be lifted by two superposed screws turning in opposite directions. He continued his experiments, a description of which may be found in Landelle's “Dans Les Airs”. He states that he patterned his later machine on the albatross which he had observed closely for some years. He had noticed a 8 distinct tendency of the wing of this bird to “Aspirate” when held in the wind. Construction was begun on his artificial bird in 1865. Two bird-like wings controlled by levers and a system of rigging were fastened to a cance-shaped body 13 ½ feet long with a maximum beam of 4 feet. A small inclined mast supported the pulleys. The wings were each 23 feet long, giving a total width of 50 feet and an area of about 215 square feet. The weight was 92 pounds. The tail was mounted on a universal joint. The front edges of the wings were mounted on a piece of flexible wood shaped like the front edge of an albatross' wings. The wings could be given a rotary motion and the surfaces given a different angle of incidence. This is the first mention of the application of this principle later used by the Wright Brothers. The aviator stood upright and operated the tail with foot pedals. He started the machine by fastening it to the top of a cart with a slip knot and causing the cart to be driven into a ten knot breeze. He attempted to rise, but the slip knot failed to work. The machine, however, showed a marked tendency to lift and finally tore away the rails of the cart. The horse was then moving at a gallop. The bird rose to the height of about 300 feet, carrying with it the driver of the cart who had become fastened to it in such a way that his weight acted very much as a tail of a kite. Le Bris, finding he had picked up the driver brought his machine gently to the ground after traveling forward about 600 feet into the wind. On releasing the driver he tried again to rise, but did not succeed. The machine was blown over on one side, damaging a wing. Upon completing his repairs, he erected a mast with a swinging yard on the 9 100 feet above the bottom of the quarry, facing the wind. Upon being released, it glided well at first, but dropping below the edge of the quarry, it was struck by a vertical gust which destroyed its equilibrium. Under Le Bris' manipulation the machine partially recovered itself, but fell almost vertically to the ground. It was badly smashed, the operator at the same time breaking a leg. It failed for lack of longitudinal equilibrium. He was able to control it laterally however, by flexing the wings.

In 1867 Le Bris completed his second machine which was lighter than the first, though provided with a moveable counter-weight which was intended to provide automatic equilibrium. One successful attempt was made in a light breeze by starting from the back of a stationary cart. He rose, probably a dozen feet and gliding about twice as far came down without mishap. After numerous other attempts, none of which were successful, and in many of which the machine was injured in starting, he finally succeeded in flying it as a kite with ballast, and once had it travel 200 feet against the wind at a height of about 50 feet. He was never able to duplicate this performance, and in one of his later experiments the machine was again badly smashed. His funds being exhausted, he gave up further attempts to solve the problem. (See Chanute's Progress of flying machines, pp. 21, 52, 81, 104 through to 110, 121, 166, 202, 208, 255, 263.

In July of 1863 a prominent photographer of Paris by the name of Nadar invited to his reception rooms the elite of the press, science, and artists, and treated them to a first 10 reading of his famous “Manifesto Upon Aerial Automotion” which appeared the next day in the press and was republished and commented upon throughout the whole of Europe. He expressed the opinion that the principal obstruction in the way of navigating the air was the attention that had been given to balloons; that in order to imitate nature, the flying machine must be made heavier-than-air, and that the surest way of success was the employment of the aerial screw. He proceeded to form a syndicate to promote aviation. A journal was founded, the first “Aeronaute”, which failed after the fifth issue owing to lack of funds. The syndicate did considerable experimenting with screws with which they were able to lift 32 pounds per horse-power. (See Chanute's Progress of Flying Machines pp. 53, 54, 55, 253).

In 1866 F. H. Wenham of England published his paper on “Aerial Locomotion”, in which he gives an account of the performances of a number of man-lifting kites. He invented a method of varying the pitch of a screw by constructing it of two cross arms mounted on a shaft with cloth stretched between the two arms. One of the arms was so mounted that by adjusting the screw could be given any desired pitch. Having noticed how thin a stratum of air is displaced below the wings of a bird in rapid flight, he patented in 1866 a method of superposing planes or surfaces one above the other so as to increase the supporting area without increasing the leverage. He built a machine of five planes, one above the other, each 16 feet by 15 inches, containing in all 100 square feet, and 11 a second of six planes each of the above dimensions, containing in all 120 square feet. With both of these machines he was able to glide short distances. These were the fore-runners of all present day superposed machines, the main difference being that the surfaces were not rigid. Hargrave, as we shall see later, was the next to adopt this plan, introducing several improvements. (See Chanute's Progress of Flying Machines, pp. 56, 59, 67, 99, 100, 103, 113, 174 to 177, 231, 253, 272).

A. Penaud, following in the steps of Launnoy and Bienvenue, in 1870, when but 20 years of age, constructed, in Paris, his small model of a helicopter driven by two superposed screws actuated by twisted rubber by which they were turned in opposite directions. He was able to cause this to rise to a height of 50 feet. The device has since been widely copied and is the one upon which all such toys, as are now so often seen are based. In 1871 he constructed a model aeroplane which consisted of following surfaces, a forerunner of Langley's machine, that possessed automatic equilibrium. The lateral equilibrium was attained by bending up the wing tips, and the longitudinal by two small following planes which were set at an angle of 8 degrees below the horizon of the leading planes. The center of gravity was placed a little in front of the center of pressure, causing the machine to progress by swoops. It was driven by a single screw turned by a twisted rubber band. In 1872 he built a model of a mechanical bird whose flapping wings were also driven by a twisted rubber band. The model flew 50 feet in 7 seconds. He accomplished 12 a tremendous amount of work during the short time which was alotted to him. Among other useful devices, he invented a balloon valve, a delicate barometer, and a system of studying bird flight by means of instantaneous photography, afterwards carried out by Marey. He also contributed a number of valuable papers to L' Aeronaute, in one of which he mentions that ascending currents are not rare, and are quite sufficient to account for the soaring flight of birds. His last work was accomplished with the aid of a mechanic by the name of Gauchot. It was to construct a large two-man-carrying machine. The design was completed, but he was not able to negotiate the funds. He died shortly after, in 1880. (See Chanute's Progress in Flying Machines pp. 28, 40, 45, 55, 56, 99, 117, 118, 119, 120, 121, 122, 123, 124, 132, 138, 184, 189, 190, 224, 258.)

Commandent Renard of the French Aeronautical War Establishment at Chalais designed in 1873, and exhibited in 1879 a “Dirigible Parachute”, which closely resembled a venetain blind somewhat similar to H. F. Phillips', of which the different members were flat planes superposed above an oviform body. In 1889 he also published the results of the propeller experiments performed in connection with the construction of the balloon “La France”. He was one of the most eminent of the French contributors to the art of flying. He also conceived the idea of the hinged propeller which principle is embodied in the driving parts both La Ville de Paris, and in the dirigible designed by Major von Parsifal of the German Army. (See Chanute's Progress in Flying Machines, pp. 70, 71, 164, 166, 170, 253.)

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A French Engineer by the name of Victor Tatin constructed in 1876 a mechanical bird driven by a rubber band. In 1879 he built two compressed air model aeroplanes which flew successfully. He was able in these machines to lift 110 pounds per horse-power. He was also connected with Profe ? s sor Marey in the latters work on the flight of birds; designed Count de la Vaulx's dirigible; and has ac c t ed as consulting engineer in the construction of the various French War Balloons. He also designed the heavier-than-air machine recently used by Count de la Vaulx, which was the first machine in France to fly at the first trial. This took place in 1907. He has done a great deal of valuable work on the subject, much of which may be found in the numbers of L' Aerophile, and still a i s actively engaged in promoting aviation in France. (See Chanute's Progress in Flying Machines, pp. 30, 41, 137, 139, 140, 141, 226, 254; also L' Aerophile for 1906, 1907, 1908).

Goupil, a distinguished French Engineer built a machine in 1883 for the purpose of studying the equilibrium of aeroplanes. He also constructed, about this same time, a steam engine weighing 42.5 pounds per horse-power. He has made many valuable contributions to this subject, many of which may be found in L' Aerophile, and is still actively at work. He, Tatin, and Commandent Renard are the three men to whom France owes most of her present progress in the art of flying. (See Chanute's Progress in Flying Machines, pp. 9, 40, 154, 155, 156, 157, 158, 1 1 6 6, 202, 262; also L' Aerophile).

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F. W. Breary, The Honorable Secretary of the Aeronautic Association of Great Britain, in 1879 constructed a flying model driven by the wave motion of large and loosely stretched wings, very much on the same principle used by the skate in propelling itself through the water. He was first to use the “pectoral cord” in models driven by flapping wings. This was in 1885. (See Chanute's Progress in Flying Machines, pp. 84, 85, 143, to 147, also “Flying”, an English publication).

Lawrence Hargrave began his work on flying machines in 1883, and read his first paper on “Trochoided Planes” before the Royal Society of New South Wales. Altogether he built eighteen models of increasing size, all of which flew. He does not believe in taking out patents, but as a general rule gives to the world any discoveries which he makes during his experiments. He exercises the greatest care in all his work making careful measurements of all parts and power, and also keeps very complete records. Up to June 7th 1893, he had read thirteen papers before the Royal Society. His first investigations were upon the motions performed by the propelling surfaces of birds and fishes, the waves these created in the fluids and the counter-action of these waves on the forms of the propelling surfaces themselves. With the data gleaned from the above, he constructed fifty models which were to produce horizontal flight. Some of these were driven by clock work. He selected the best and from their mean dimensions derived a standard form for a fresh departure. He then constructed ten various types, seven using flapping wings, one a single screw in front, one two screws in front, and one a 15 single screw behind. This last, proved to be the most servicable and practical form of the screw driven models. He states that he finds screws and flapping wings to be about equally proficient, but prefers the latter. In 1890 he constructed a machine driven by compressed air actuating flapping wings on the principles laid down by Borelli in 1680. This flew about 368 feet with an expenditure of 870 ft. pds. It had about 6.43 square feet per pound of weight. The wings had elastic back edges, so as to obtain the best results from the torsion induced in them. He used long planes to obtain longitudinal stability, but states that there is a gain in efficiency by using two surfaces with a gap between. Lateral stability was maintained by the use of a slight dihedral angle between his surfaces and the center of gravity was placed below the center of support. He found some difficulty in causing the center of gravity to co-incide with the centure of pressure. His final conclusions were that the best position for the center of gravity of a continuous surface is .25 or .2 of the total length back from the front edge. In 1890 he constructed a second model which flew 343 feet. In this one he had shortened the plane. His next machine was driven by a three-cylinder compressed air engine turning a screw propeller. The speed of this model was 10.34 miles per hour. It utilized 7 square feet per pound of weight and carried 89.5 pounds per horse-power. Up to this time he had constructed sixteen models, ten driven by rubber bands and six by compressed air. His next work was an attempt to develop a gas turbine, but was unsuccessful. He also made a 16 model boat which was propelled into the wind by the wave action on its under surface, illustrating that peculiar property known as “aspiration”. He then turned his attention to steam engines, and built one weighing 19.2 pounds per horse-power with which he drove his seventeenth model. A second weighing only 10.7 pounds per horse-power was constructed for his eighteenth model. No data on the flight of these last two models is given. To obtain data on surfaces, he next flew kites, and in 1892 conducted his experiments with cellular kites of various forms. He finally arrived at the form known as the box-kite in which he used both curved and plane surfaces. He gives credit to Wenham for suggesting to him the use of superposed surfaces in the latter's paper published in 1866. His box-kite is the model on which many of our superposed surface flying machines are based. (See Chanute's Progress in Flying Machines, pp. 218 to 266, 228, 230, 252, 254, 255, 258, 265).

Glement Ader, a Frenchman, constructed his first flying machine in the shape of an artificial bird, in 1872. With this as a basis, he continued at work on later models till he obtained recognition from the Minister of War with whose aid he completed, in 1900, at the expense of about $120,000, a large monoplane weighing 1000 pounds, driven by two propellers, carrying two wings which could be folded at the back. It was exhibited at the Paris Exposition of that year, and was also given a trial at which it succeeded in rising from the ground, but was so lacking in equilibrium 17 that it fell and was wrecked. (See c C hanute's Progress in Flying Machines, pp. 2 1 0 8, 211 to 214, also Hildebrandts' “Airships Past & Present”).

In 1888 Sir Hiram Maxim had completed his large aerodrome, built at the cost of $100,000, with an area of 3875 square feet, and weighing 7,000 pounds. It had taken him several years to evolve this creation, and it is due to the building of this machine that the present light weight automobile steam engines owed their early development. His propeller experiments have proved to be of the greatest value. The machine was tried on a circular track, so arranged that it could only rise to a very small height. It was made to lift on at least two different occasions, and the last time did so with so much force that it broke away the restraining rails and moved off across the field. By the time the power could be shut off and the machine brought to a stop, it had been very badly wrecked. The aeroplane was driven by two seventeen foot propellers turned by a steam engine. This work of Maxim's is by far the most ambitious in the field of aviation that has ever been attempted. Having exhausted the amount he set aside for his aerial experiments, he discontinued them. The tests took place in England. (See Chanute's Progress in Fly-Machines, pp. 38, 53, 68, 71, 73, 75, 84, 119, 133, 141, 154, 229, 233 to 246, 252, 254, 258, 267, also Aeronautical Annual of 1905).

Prof. S. P. Langley, third Secretary of the Smithsonian Institute at Washington, began his work in aviation in 1889. He published his “Experiments in Aero-Dynamics” in 1891 18 and his “Internal Work of the Wind” in 1893, two contributions which probably had more to do with the promotion of the subject than any others up to that time. In 1896 his model aerodrome No. 5, steam-driven, with two propellers, made two successful flights. A second and a longer flight of a quarter of a mile was made by his No. 6 machine on November 28th. He then proceeded to the construction of a large man-carrying aerodrome, and with the aid of Mr. E. M. Manley, completed it in 1903. It was driven by a 52 ½ horse-power gas engine designed by Mr. Manley for this particular purpose, actuating two propellers revolving in opposite directions and weighing but 2 ½ pounds per horse-power.

This engine to-day remains unexcelled in its ratio of weight to horse-power, being in addition water-cooled. Mr. Manley claims to have run it on a brake for nine hours, and to have obtained the above stated horse-power from it constantly for this period. The large aerodrome was built at the expense of the United States Government, Congress having appropriated a special sum for this purpose. In 1903 it was given two trials, in neither of which it was properly launched. The first time was due to the failure of the launching device, and the second to the giving way of the guy wires which supported the engine bed. The connections of these wires had been greatly weakened by the racking they had been subjected to in the preliminary tests of the engine. The press of the United States, because Prof. Langley in accordance with the directions he had received, had persistently excluded reporters from his experiments, attacked him so violently, as a result of the failure of his machine 19 to get into the air, that Congress refused to appropriate any further moneys for the carrying on of his experiments. Prof. Langley never recovered from this disappointment which he experienced at this lack of confidence. He died in 1906, his death being hastened by the constant worry which these attacks had occasioned. His machine would unquestionably have flown had it been properly launched. It was a wonderfully well constructed piece of mechanism, and its design was absolutely correct, as has been demonstrated again and again by recent investigators. He has probably done more than any other one man to place the subject on a firm scientific basis, and his work, supplemented by that of Lilienthal, may indeed be said to have fairly launched the matter in a practical way and be largely responsible for the rapid and steady development it has since undergone. (See Chanute's Progress in Flying Machines, 3, 5 to 10, 73, 104, 119, 126, 234, 240, 251, 254, 255, Aeronautical Annual for 1896 and Smithsonian Publications).

Otto Lilienthal, a mechanical engineer of Germany, is the man whose example of actually traveling in the air put the whole subject on a solid practical foundation and inspired Pilcher, Chanute, Herring and the Wrights to follow in his foot steps. He began his work in aviation in 1861, at the early age of thirteen, and continued it from then on till his death in 1896. In his odd moments for 10 years with his brother's assistance he constructed numerous models of flying machines.

His serious work covered a period of 25 years. It began 20 with the systematic analysis of the problem as it appeared to him, and was continued by careful investigation and experiment. He studied bird flight and the forms of bird wings and investigated carefully the resistance and reaction of air on various surfaces and the power necessary to maintain flight. His earliest out door work was to suspend himself from a spar in a machine which consisted of two wings, and gain experience by trying to exert a certain measure of control over the apparatus in comparatively high winds. This occurred in 189 ? 1 . In 1892 he constructed another apparatus of 107 square feet, weighing 53 pounds. The surface of this was later ? r educed to 86 square feet, and its weight to 39.6 pounds. He first practiced jumping off a spring board set up in his garden. After acquiring considerable dexterity in handling his apparatus, he went to a nearby hill and practiced running down the slope with it into the wind. His relative velocity was about 23 miles per hour, but he was un able to handle the apparatus at first in a wind stronger than 11 miles per hour. Later he was able to control it in velocities up to 16 miles per hour. His most favorable glides were about one on eight, or seven degrees, and his longest distances about 200 and 300 meters. His first machine consisted of a single pair of wings with a curvature of about one in twelve supplemented with a vertical and horizontal tail. He later built gliders of superposed surfaces, completed plans for a motor-driven machine, and then constructed an engine weighing 88 pounds which would deliver 2 ½ horse-power for four minutes. His intention was to have it actuate surfaces so that 21 they would imitate the rowing flight of birds. In August of 1896 he was experimenting with an old glider, which he intended very shortly to replace with this new machine, and which was said to be in such condition as to make continued use of it very hazardous. Although he had been warned of its condition by his assistants and its need of overhauling, he omitted to have it repaired. On the 9th while in mid-air, the machine, as had been predicted, collapsed, some of the guy wires parted and it fell with its operator from a height of about 45 feet, breaking Lilienthal's back, and an injury from which he died in a few hours. He was the first experimenter to realize that learning to balance is the first great problem of flight, and is probably the greatest contributor to aviation, in that he himself demonstrated the feasibility of actual practice in the air. (See Chanute's Progress in Flying Machines pp. 196, 201 to 211, 214, 263, also Aeronautical Annual of 1896).

A contemporary of Lilienthal, and one of the first to follow in his footsteps, was Pilcher, of England, who in 1895 started to imitate Lilienthal's flights. He made several glides in Lilienthal's own machines in Germany; and was the first of the later workers to cause himself to be raised in his machine by having it towed as a kite. On reaching the desired height, he would cut the machine loose and glide down to the ground. Pilcher continued his experiments to 1899 and became very expert in handling his glider to which he found it very convenient to attach wheels to aid him in manoeuvring it on the ground. In this same year an apparatus which had developed certain structural defects collapsed with him in the air, and he was killed by the fall. As the result of his tests he discarded surfaces which at what is ordinarily known as the dihedral 22 angle for those which droop after the fashion of a gulls wing. This latter form he found more stable, particularly in high winds. These conclusions were later confirmed by Chanute, Herring, and the Wrights. (See Aeronautical Annual of 1896 and Moedeboeck's Hand-Book).

Octave Chanute, one of the foremost civil engineers of this country, although a Frenchman by birth, published in 1893 his “Progress in Flying Machines”, the only authentic and reliable work that has yet appeared on this subject and from which I have obtained most of the material for this article. In 1896 he set aside a certain sum of money, about $10,000, which he intended to devote to practical aerial experiment, and accompanied by the aid of Mr. Herring, and Mr. Avery of Chicago set up a company the sand dunes along the shores of Lake Michigan; the first really successful apparatus used was designed by Herring. They began with the Lilienthal type, but found it very unsatisfactory, and then tried multiple following wings, but very quickly replaced them with multiple superposed wings. In order to control the change of the center of pressure, the lack of which had proved disadvantageous in Lilienthal's apparatus, the wings were first made moveable. This corrected the difficulty to a certain extent, but it was not until the adoption of Herring's spring tail, which we also find on Langley's successful models and large machine, that they attained any marked success. From then on good results were obtained with the two superposed surfaces. Later in 1902, Mr. Chanute designed a system with pivoted wings which proved satisfactory. Hundreds of glides were made by these experimenters without a serious accident. 23 Their best apparatus weighed about 23 pounds. Since 1902 Mr. Chanute has not done any active work other than assist Herr Moedeboeck in the compilation of his hand-book, but he has devoted his extensive knowledge of the subject to the free assistance of all who have cared to call upon him for his advice and help. (See pp. 296 to 300 Moedeboeck's Hand-book; also Aeronautical Annual of 1895 and 1897).

Professor Alexander Graham Bell took up kite flying as a pastime seventeen years ago, starting with cellular structures in the form of hexagons and parallelograms. He next tried triangles but being dissatisfied with the necessity of introducing guys to strengthen these forms, he finally turned to the tetrahedron as the most economical unit of all. Great difficulty was encountered at first in fastening these units, or cells together, but after persistent effort extending over a course of about six years, the present simple and efficient system was evolved. In the summer of 1907 he was ready to turn his attention to the problem of converting his kites which because of the great number of cells and dihedral surfaces are very steady flyers, into motor driven flying machines, and on December 6, 1907, sent up his large structure, The “Cygnet” consisting of 3393 cells covered with 184 square meters of silk, carrying Lieut. T. Selfridge, 1st U.S. Field Artillery. The kite was flown over the water, but was completely demolished on alighting, due to inexperience of the men stationed at the flying line. Important and full data were however obtained. In the latter part of July 1907, Prof. Bell suggested to Messrs. G.H. Curtiss, F. W. Baldwin, J.A.D. 24 McCurdy and Lieut. Selfridge that they associate themselves with him for the purpose of putting a practical aerodrome in the air, stating that Mrs. Bell had requested that she be allowed to furnish funds for the promotion of the experiments of some such body. As a result, the Aerial Experiment Association was formed on October 1st, 1907, with the above object, the funds for its investigations and experiments to be furnished by Mrs. Bell. Since its formation they have put up a man in a tetrahedral kite for seven minutes, built two aerodromes, No. 1 the “Red Wing”, which made two flights of 107 yards and 40 yards, and No. 2 the “White Wing” which made five flights of 45, 33, 79, 205 and 134 yards: total, 679 yards, or 826 yards for both. They are now constructing their No. 3 machine.

A. M. Herring, whose interest had been aroused by Lilienthal's example, commenced experimenting in the early part of the last decade. He began gliding with a Lilienthal type of machine as early as 1893, and in that year also completed a very efficient model driven by rubber bands. He was one of Prof. Langley's assistants during the latter's earlier experiments, and later, in 1896 and 1897, joined Mr. Chanute in his work in the vicinity of Chicago. There he designed the party's most successful glider, which has since been erroneously known as the Chanute type. We find his spring tail, mounted on a universal joint, used in all of Prof. Langley's successful models, and in the best of the gliding machines used by Chanute. He was also the first in this country to use super p osed surfaces built up in the form of an ordinary ? b ridge 25 truss; as well as the first man, so far as is known, to have made a flight in a power driven machine; on the 11th and 22nd of October, 1898, at St. Joseph, Mich., he flew a distance of about 73 feet in a machine driven by two propellers actuated by a compressed air engine. This flight took place in the presence of witnesses, and an account of it appeared in a Chicago evening paper of a some ? w hat later date. This machine carried 162 square feet of surface, weighed 251 pounds, and was driven by a five horse-power motor. He is now under contract to deliver a two-man machine to the United States Government about the middle of August and has an order to build a similar one for Mr. McCoy of the Aero Club of America. (See Aeronautical Annual 1896 and 1897, Moedeboeck's Hand-book and the May number of the American Aeronaut).

James Means of Boston published, in 1895, 1896 and 1897 the three volumes of the Aeronautical Annual which is the best, and one of most exhaustive reviews of the fourth chapter, or period of the progress of aviation. He is one of that small coterie of prominent men, Langley, Chanute, Bell, Maxim and himself who would have rendered the art an incalculable aid by the mere lending of their names to the subject, had they been content with that alone. He is now actually and energetically working in connection with Octave Chanute, A. Lawrence Rotch and Alexander Graham Bell in raising by August 1st next a $25,000 aviation prize for 1908.

Interest arroused by the report of Lilienthal's death in 1896, caused the Wright Brothers, Wilber and Orville, now of international fame, to take up the subject of aerial navigation. 26 Their first idea was to make a glider fly as a kite, so that they could remain in the air for some appreciable time, and thus become used to the sensation of being in the air, for on investigating the thousand flights of Lilienthal, they found that he had not spent more than a total of five minutes in the air. They did not complete their first practical apparatus until 1900, but following Lilienthal's death they devoted much time and thought to the matter and decided fully just what they wanted before they tried their man-carrying apparatus. The following radical changes from the type of glider designed by Herring and used by Chanute were made.

1. They decided to do away with the tail.

2. They provided for lateral equilibrium and steering to the right or left by a peculiar torsion of the main surfaces which is equivalent to presenting one end of the wings at a greater angle than the other. (First tried by Le Bris).

3. They introduced a front moveable plane with which to compensate for the moveable center of pressure, being the first advocates of this method now so generally adopted throughout the world.

4. They moved the forward main cross-piece to the extreme front edge.

They enclosed all members and ribs other than struss in the cloth of the plane.

5. They re-arranged the wiring so that all of the wires could be tightened by merely shortening two of them.

A slight conception of the work done by them between 27 1896 and 1900 may be gathered from the above, a great deal of which was original. Their glider was constructed so that it could fly loaded in an 18 mile wind. They found from the very first that the calculations of early investigators were going to be of little assistance, and between 1900 and 1903 they practically went over the whole ground in their own Laboratory. For their outdoor experiments they moved to the Kill-Devil Hills of North Carolina, where they spent their summers gliding from the tops of Sand Dunes. They continued this during 1901, 1902, and 1903. Their 1901 machine differed but little from that of 1900. Early in 1901 they tried increasing the curvature in their surfaces, but found that this detracted greatly from the longitudinal equilibrium possessed by their 1900 glider, whereupon they returned to that of the latter. In 1902 they added a vertical tail to augment the steering from right to left derived from their system of twisting the surfaces and to counteract the tendency of the machine to turn at each attempt to right it. Toward the end of 1903 they had practically completed their gliding experiments and had constructed a power-driven model carrying an engine of 12 horse-power. With this they made a flight on December 17th, 1903, the second men in the world to get in the air in a dynamic flying machine, and the first to fly in a machine supplying its own power. They continued their work on the subject in 1904, making short flights, and striving to overcome to many difficulties which they encountered. They did not attain any great measure of success until 1905, when, on September 26th, they made a flight of 11 # miles with a 28 machine driven by a 25 horse-power gas engine. This motor was their third, their second being a 15 horse-power engine used in their 1904 experiments. On September 29th they flew a distance of 12 miles; on October 3rd, 15 ¼ miles; on October 4th 20 ¾ miles, and on October 25th 25 # miles in

38.03 seconds. In 1906 when the relations between France and Germany were somewhat strained over the Morrocco question, France ordered a flying machine from them and put up bond of $5000. This she later forfeited upon the situations becoming less acute. They resumed their experiments in May, 1908, and are reported to have made a flight of eight miles at a speed of 60 miles per hour. The newspapers of recent date have contained numerous articles concerning these flights, but the accuracy of their statements must be seriously questioned, as the flights are said to have been observed by the reporters from a distance of not less than two miles. It is stated that in their last flight in which they covered eight miles, their machine was completely demolished by an untimely accident. The operator, however, sustained no injury. Many of these tests were made with the machine carrying two men. They are now under contract to furnish a machine to the United States Government about August 20th of this year. (See Smithsonian Publications and Moedeboeck's Hand-Book).

29

AN ACCOUNT OF RECENT EXPERIMENTS WITH DYNAMIC FLYING MA T C HINES.

William Kress, an engineer of Vienna, in June of 1901 constructed a very promising device which consisted of three sets of planes arranged in a form known as the Langley type which possessed 1000 square feet of surface. It was to be launched from the water, and for this purpose it was mounted on two narrow aluminum floats. These were constructed for use over ice and snow as well. It was driven by an 18 horse-power Daimler motor weighing 840 pounds. I j n the trial it attained considerable speed over the water, but on attempting to turn it was capsized by the wind that was then blowing, and so badly damaged that it was abandoned, being picked up several days later on the shore. It did not succeed in rising. (See Hildebrandt's “Airships Past & Present”).

Earnest Archdeacon, the man to whom more than to any other is due the tremendous activity recently displayed by the French, formed a Commission of Aviation in the Aero Club of France in 1903. In April of 1904 he had built a gliding machine very much like that used by the Wrights, with which he conducted numerous experiments. In the same year he put up a cup for the first machine that would travel over 60 meters. This was won by Santos Dumont, on October 13th, 1906. With Henri Deutchede la Meurthe, he put up the Grand Prix of Aviation of 50,000 francs ($10,000) for the first aviator to travel a kilometer in a closed circuit. This was recently won ? 30 by Farnam on January 13th, 1908, when he covered between 1500 and 1800 meters, returning to his point of departure. In March of 1905 he flew his glider as a kite, carrying a load of sand to represent the weight of an operator. It came down unexpectedly and was badly injured. Later in the same year, he built another which was flown over the waters of the Seine. It resembled closely a two-celled Hargrave kite. It flew 400 meters, carrying Gabriel Voisin, being towed by a motor boat which was traveling about 18 miles an hour. Toward the end of the flight he cut the flying line and descended gently to the water. In September this same kite was flown over Lake Geneva. Its total weight was 300 kilograms; pull 60 kilograms; speed 10 meters per second; horse-power expended eight. These experiments demonstrated beyond question the practicality of the motor-driven aeroplane in the light of recent developments in the construction of gasoline engines. Archdeacon has since given up practical experimenting on his own part and is devoting all his energies to popularizing the art, and with what wonderful success the work accomplished in recent years and still being pushed with tremendous energy in France, attests. (See L'Aerophile 1906 and La Revue de L'Aviation, 1907).

Early in 1906, Vuia of France started work on his flying machine, and during the summer of that year is said to have made a few short flights. His first public demonstration, however, took place on October 8th, when he made a flight of eight meters. He is conceded to be the first man in Europe to have left the ground in a power-driven machine, though 31 Santos Dumont made his first off ? i cial flight on September 13th of this same year. On October 14th, Vuia again succeeded in leaving the ground. This earlier machine was driven by a carbonic acid engine designed and built by himself. It proved to be most erra ? t ic, and was undoubtedly the cause of his early failures to make long flights. He continued his experiments on January 26th, 1907, and also on March 26th, and March 27th, still using the same motor. On all of these dates he made flight none of which exceeded four meters. He then decided to discard this engine, and bought a 24 horse-power Antoinette motor which he installed in his new No. 2 machine. With this he made a short flight on June 21st, and on July 25th succeeded in flying 20 meters. The machine came down unexpectedly and was damaged, at the conclusion of this flight. No further reports have been received regarding him, although it is inferred that he is still at work. His aeroplane weighs 213 kilograms, including the operator and had 15.5 ? s quare met e rs of surface.

Santos Dumont, the second man in Europe and the fifth in the world to travel in the air in a practical flying machine started experiments in July 190 5 6 with an aeroplane which he suspended first from a balloon and then from a wire cable stretched between two points. This was subsequent to work he performed in the same year on a helicoptere that gave so little promise of success that he discarded it in favor of the aeroplane. When he felt he had gained sufficient control over it, he had an engine installed, and September 13th, 1906, at Bagatelle, he made a flight of from 7 to 8 meters. On 32 October 13th he won the Archdeacon cup for a flight of 60 meters. This first aeroplane was his No. 14, had a surface of 52 square meters, weighed 300 kiolgrams and attained a speed of 30 kilometers per hour. He used a propeller two meters in diameter with a pitch one of meter weighing eight kilograms. He travelled about 100 meters over the ground before rising. On October 23rd, af ? t er he installed a 50 horse-power motor, and reduced his surface to 50 square meters, he made a flight of 100 meters. On November 12th, he made flights of 40, 60, and 220 meters. He later built a second machine with which he had but little success, of 14 square meters, weighing 200 kilograms, and having a 50 horse-power motor. On November 16th, 1907, in his No. 19 or third aeroplane, which was made of bamboo and metal covered with varnished silk, driven by a 17 horse-power motor, had 10.2 square meters of surface, and wiehged 110 kilograms, he covered at the third attempt 200 meters. On November 17th, he made three flights of 100 meters, 50 meters, and 100 meters.

On the 30th of March 1907, the Voisin Brothers completed an aeroplane designed by Leon DeLagrange very much along the lines of the kite flown by Archdeacon over Lake Geneva. On this date Charles Voisin, one of the builders, made two flights one of 25 meters and the other of 60 meters, and on April 8th, the same operator flew 50 meters. DeLagrange ordered a second machine which he first took out for trial on January 20th, 1908, and in which he made his first flight of 100 meters. On March 21st after a flight of 1500 meters, DeLagrange orders took Farman in the machine for a flight of 50 meters, the first two-man flight in France. On April 10th after constant practice 33 he covered 2500 meters in a circle, and on April 11th 3920 meters in 6 minutes, 30 seconds, thereby winning the Archdeacon cup from Farman, whose best flight of 2005 meters was made on March 21st. DeLagrange himself, was, however, the ninth man in France to get into the air. He is now making flights in Rome. (See L'Aerophile and Current Publications).

In October of 1906, Bleriot and Voisin tried their first machine over the water. ? I t was unable to rise. Bleriot then ordered a new apparatus which was completed in time for him to make short flights of five and six meters on April 6th and 7th, 1907. On July 11th he flew 25 to 30 meters and 78 meters in his No. 3 machine; On July 25th he covered 120 meters and 150 meters; on July 31st, 125 meters; on August 1st 100 meters; on August 6th he made two jumps in a continuous run, of 120 and 143 meters, and on August 10th he made a flight of 80 meters. All these flights were accomplished with a 24 horse-power motor. He now replaced it with a 50 horse-power motor, driving a four-bladed propeller, from which he obtained a pull of 286 lbs. With this new machine, on September 5th, he flew 200 meters; on Spetember 11th, 90 and 100 meters; September 12th, 100 meters; September 17th, 124 meters; November 16th with still another machine, No. 5, he made a short flight at a speed of about 80 or 90 kilometers per hour. He broke his wheels on landing. On November 29th he flew 150 meters; December 4th 50 to 200 met e rs and December 6th he twice flew between 400 and 500 meters, and also completed a turn in the air. On December 18th he flew 145 meters, but later on the same day smashed the machine badly in another trial. Altogether he had 34 nine machines built for him.

September 30th 1907, Henry Farman made his first flight of 30 to 80 meters in a machine built for him by the Voisin Brothers along the same lines embodied in Delagrange's. He practiced constantly and on October 15 ? t h flew 300 meters; October 19th, 100 meters; October 23rd 170 meters, and keeping at it daily he succeeded on October 26th in covering 771 meters. He had now totalled 2.6 kilometers. On November 1st and 2nd he made short flights, and on November 5th, he flew 300 and 400 meters. On No b v ember 9th, he was able to execute a turn, and on November 10th, in a flight of 800 meters, he completed ¾ of a circle. He still continued to practcie at every favorable opportunity, and on Januray 11th, 1908, he was twice able to return to his starting point. On January 13th he won the Deutche-Archdeacon prize of 50,000 france by flying between 1500 and 1800 meters and returning to starting point. He made his longest flight to date, of 2005 meters on March 21st 1908. March 27th he had aserious accident while practicing curves, in which his machine was badly smashed. He escaped from the wreck with but slight injuries. On May 9th he is reported to have flown 700 feet with his father as a passenger, and carrying eight gallons of water for cooling the motor, and 2.6 gallons of alcohol for fuel. (See L'Aerohpile and Current Publications).

Robert Esnault-Pelterie, early in 1903, began gliding experiments with a machine very similar to that used by the Wright Brothers, and acquired considerable facility in handling it. He continued experimenting and finally on October 22nd 35 1907, had completed a power-driven monoplane of 18 square meters surface, w i e ighing 230 kilograms and carrying a 35 horse-power motor, with which he flew 150 meters on that date. On October 26th, he flew 100 meters and turned in the air. On the 27th he again flew 100 meters. He built a second machine of 16 meters surface, weigh ing 300 kilograms with which he made short flights in November. To date his machines are by far the best constructed and most scientific. He said to now have four more machines which he is keeping in reserve all of which he hopes to try out this year. Two of these machines are of 30 horse-power and two of 60. One of the latter is to carry two people. (See L'Aerophile and Current Publications).

The motor which he designed himself consists of seven cylinders, operating two cranks, four on one and three on the other. It is light and said to be quite efficient.

Pischoff completed his two-surface aeroplane in time to make short fl g i ghts on December 5th, and 6th, and 1907. On January 15th, 1908, he made three flights of 30, 40 and 80 meters. He is still experimenting (See L'Aerophile).

Count de laVaulx in a machine designed for him by Victor Tatin of 40.6 square meters of surface, weighing 400 kilograms and driven by a 40 horse-power motor actuating two propellers two meters in diameter with a pitch of 2.2 meters, which was, however, remodeled so as to consist of 13 square meters of surface and carry a 24 horse-power motor, flew 50 and 70 meters on December 18 y t h 1907; In the latter flight, which was made before a very heavy wind, the machine collapsed in the air, but fortunately, with no harm to the operator. (See L'Aerophile and Current Publications)

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The Gastambide-Mengin machine was flown by Boyer for a distance of several meters on February 8th 1908 ? It weighed 350 kilograms, had 24 square meters of surface and was driven by a 50 horse-power motor. On February 12th it made flights of 100 meters and 150 meters and on February 14th it flew 60 meters, but struck one wing and turned a complete somersault, damaging the machine badly. No front control was used, the height being regulated entirely by the speed of the motor. (See L'Aerophile).

Sept 12, 1906- with no 2 machine Ellehammer, a Dane, is said to have made a number of short flights during 1906, on the Island of Holm. He used at that time a nine horse-power motor mounted in a single surface machine. Altogether he has tried three types of aeroplane: a mono-bi- and tri-plane. His second apparatus had 37 square meters, weighed 34 kilograms without the operator, and used a 30 horse-power motor to drive a four-bladed propeller at 900 revolutions per minute. Its total weight in flight is 205 kilograms. On July 24th 1908, he made an unofficial flight of 175 meters, and on February 13th with his last machine of 27 square meters, he made an official flight of 300 meters. Altogether, he is said to have been in the air 200 times. (See L'Aerophile and Current Publications).

In Bohemia, Messrs. Ettrich and Wels conducted gliding experiments in 1907. Their best glides are said to be about 200 meters, at a speed of about 12 meters per second. They have since built a motor-driven aeroplane, but no reports have yet been received concerning it. (See L'Aerophile).

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The Breguet Brothers, on September 29th, 1907, were able to lift an operator in their heilcoptere to a height of 1.5 meters. This was their second success, the first taking place on September 16th when the machine rose to a height of 60 centimeters. They are the first experimenters to have built such a type of machine which was able to get off the ground with its motor and aviator. (See L'Aerophile and Current Publications).

On August 30th, 1907, the ? C ornu Brothers caused their helicoptere to lift itself and engine. On September 27th they lifted 235 kilograms and on November 13th, the machine lifted itself and operator to a height of 30 centimeters, and descended on account of the belt slipping. On the same day it is asid said to have also taken up two men, or 328 kilograms, but being unb a lanced, descended without attaining any great height. It consists of two screws arranged in the same plane, driven by a belt which is connected with a 34 horse-power Antionette motor.

There have been numerous other aeroplanes, helicopteres, and ornithopteres constructed in Europe, but the above mentioned ones alone have made authentic flights.

In this country the only public flights so far made have been those accomplished by the Aerial Experiment Association with its two machines, “The Red Wing”, and “The White Wing”. The former consisted of two superposed tapering aeroplanes arranged in the form of a spar shaped truss. It was driven by a 40 horse-power motor which, however, did not tur n its propellers whose diameter was 6 feet, 2 inches with a 38 pitch of four feet, more than 1000 revolutions per minute, thus delivering at the time not more than 20 horse-power. The apparatus was provided with a front control and a tail, and had 385 square feet of supporting surface. Its total weight with operator was 570 pounds. This apparatus was constructed and ready for trial in just seven weeks. On March 11 9 , 1908 it was run over the ice, and its steering gear thoroughly tested, but no t attempt made to fly. On March 12th, it made a flight of 318 feet, 11 inches, carrying F. W. Baldwin of Toronto, Canada in the aviator's seat. On March 17th Mr. Baldwin again made a flight in the machine, covering a distance of 120 feet. In the first flight, the aeroplane traveled about 200 feet from the start before rising, and only 50 feet in the second attempt. The machine was badly damaged when landing after this second flight, and it was decided to build another structure rather than repair the old one, as it was intended to make numerous changes. The new machine was commenced March 23rd, and was ready for trial on May 9th. The form of the machine which was known as aerodrome No. 2, or “The White Wing”, was much the same as “The Red Wing”, the only radical change being the addition of moveable wing tips which were expected to aid in the control of the lateral equilibrium. There were numerous improvements made in the details of construction. This second machine made its first flight on May 18th, guided by Mr. Baldwin. It covered about 40 yards. The run n ing gear proved defective, and no further flights were attempted that day. On May 19th Lieut. Selfridge make two flights, one of 35 yards, and the 39 other of 79 yards. The greatest height was attained in this last flight, being being between 30 and 40 feet. On coming down, the front plane was damaged, and the running gear broken. The machine was again ready for flight on May 22nd, when, under the guidance of G. H. Curtiss, it covered a distanne of 339 yards lightly touching the ground however, after it had traveled a distance of 205 yards. This occurred late in the evening, so that experiments were given up for the rest of the day. On the 23rd, the machine, carrying Mr. McCurdy, made a flight of 183 yards, at the end of which one wing touched the ground, causing the machine to strike its nose and turn turtle. This accident badly damaged the apparatus which however, is now being re-built and should be ready for trial in about two weeks. Aerodrome No. 2 proved to be most satisfactory, considering that it was never using more than 23 horse-power. Its average speed was about 38 miles pre hour, at which it fully demonstrated the practicability of its controlling gear, the accidents all being due to the inexperience of the operators, and not to any defect developed in the aerodrome. Its area was 408 square feet, and its greatest weight 650 pounds with the operator.

Since 1906 the following machines have been under cosnrtcution constructions :— “This list is merely presented to give some idea of the tremendous activity which is taking place in the w ? ? orld in the promotion of aviation. There are doubtless numerous machine which are not mentioned here, these being only those which have been announced in recent publications”.

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IN FRANCE we find the aeroplanes of

No. 1 Vuia, two machines,

No. 2 Santos Dumont, three machines,

No. 3 Tatin, two machines,

No. 4 Pompeien Priaud, four machines,

No. 5 Blériot, nine machines,

No. 6 Kapférer, two machines,

No. 7 Ferber, one machine,

No. 8 Delagrange, two machine,

No. 9 Zens, one machine,

No.10 Seux, one machine,

No.11 Esnault-Pelterie, six machines,

No.12 Farman, two machines,

No.13 Barlatier and Blanc, one machine,

No.14 Gilbert, one machine,

No.15 Reissner, one machine,

No.16 deDion, one machine,

No.17 Bollée, one machine,

No.18 Dardelet, one machine,

No.19 Vinet, one machine,

No.20 Blanc, one machine,

No.21 Auffin and Ordt, one machine,

No.22 Gasnier, one machine,

No.23 Jacquelin, one machine,

No.24 Pischoff, one machine,

No.25 Bourdariat, one machine,

No.26 Bellocq, one machine,

No.27 Goupil, one machine,

No.28 Gastambide-Mengin, one machine,

No.29 Thuau, one machine.

The following helicopteres have been, or are being constructed in France:—

No.30 Santos Dumont, one,

No.31 Cornu Brothers, one,

No.32 Bréguet, one,

No.33 Léger, one,

No.34 Jules Félipe, one,

No.35 Bertin, one.

The following are French Ornithopteres:—

No.36 Bazin, two,

No.37 Collomb, one.

Making a total in France of 61 machines.

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IN ITALY the Government ordered in 1907, a glider of the Herring type, from the Voisin Brothers.

1. Vincenzio Florio has ordered a machine from the Voisin Brothers.

2. Salviotti, an ornithoptere,

3. Henry Savage Landor, a machine of original desi ? gn at his country home, ?? making a total in Italy of 3.

IN GERMANY there are three aeroplanes of

1. Etrich-and Wels, one,

2. Coanda, one,

3. Suring, one,

4. Zatho, one,

Making a total of 4.

IN SWITZERLAND :

The Dufux Brothers an aeroplane.

IN DEMARK :

Ellehammer, three aeroplanes:

IN RUSSIA :

Shabsky, one aeroplane.

IN ENGLAND :

Phillips, an aeroplane,

Bellamy, an aeroplane,

Dunn, an aeroplane,

Roe, an aeroplane,

Moore-Brabazon, an aeroplane,

Making a total in England of 5 aeroplanes.

Altogether IN AMERICA the following power driven machines have been, or are being built:

Herring, two aeroplanes, one for the Government, and one for Mr. McCoy in 1908.

The Wright Brothers, three aeroplanes, one of which is for the Government.

C. C. Jones, three aeroplanes for the International Vehicle Company.

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The Aerial Experiment Association, two aeroplanes.

Roshon, one aeroplane,

Beach and Whitehead, one aeroplane.

Bowland, one aeroplane.

Gammeter, an ornithoptere.

Myers, two ornithopteres.

Luyties, helicoptere.

Kimball, helicoptere.

Williams, helicoptere.

Making a total in America of 19 machines.

This makes a grand total of 97 machines, and is not, I believe more than 60% of the whole.

Twenty-five of these, or over 26% have actually flown, or left the ground, and have carried into the air 22 different men who are:

1. Herring, 1 machine.

1 machine.

2 Orville Wright

3. Wilbur Wright

4. Vuis, 2 machines.

5. Santos Dumont, 2 machines.

6. Ellehammer, 3 machines.

7. Charles V is oisin, 1 machine.

8. Blériot, 4 machines.

9. Farman, 1 machine.

10.Bréguet, helicoptere, 1 machine.

11.Esnault-Pelterie, 2 machines.

12. Cornu, helicoptere, 1 machine.

13.PP u i schoff, 1 machine.

14. Count de la Vaulx, 1 machine.

15. Delagrange, 1 machine.

16.Boyer (Gastamhide-Hengin) 1 machine.

17.F.W. Baldwin, 2 machines.

18.Furness, (With Wrights).

19.Farman (Father and Henry Farman).

Aerial Experiment Association.

20Lieut. T. Selfridge.

21. G. H. Curtiss,

22. J.A.D. McCurdy

Nor must we forget that in addition to the above there were Maxim's, Herring's, Ader's, Kress' and Langley's machines all built on rational lines and all probably capable of flying.

This activity is manifesting itself in the United States, England, France, Germany, Italy, Russia, Denmark, Switzerland, Austria, in all nine different countries. The two leading manufacturers of aeroplanes to date are the Voisin Frères of France and the Curtiss Manufacturing Co., of

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BULLETINS OF THE Aerial Experiment Association

Bulletin No. III Issued Monday, July 27, 1908

ASSOCIATION'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN NO. III ISSUED MONDAY, JULY 27, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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THE BULLETINS OF THE AERIAL EXPERIMENT ASSOCIATION: by A. G. Bell.

The Bulletins of the A.E.A. are prepared by Dr. A. G. Bell, Chairman of the Association; and are typewritten by his Private Secretary, Mr. Charles R. Cox. Mr. Cox makes one original and six carbon copies which are distributed as follows:

1. Association Copy (the original)

2. Dr. A. G. Bell's Copy.

3. Lieut. T. Selfridge's Copy.

4. Mr. F. W. Baldwin's Copy.

5. Mr. J.A.D. McCurdy's Copy.

6. Mr. G. H. Curtiss's Copy.

7. Beinn Bhreagh Laboratory Copy.

Bulletin No. 1 was issued Monday, July 13, 1908; No. II, Monday July 20; and the present Bulletin No.III appears Monday, July 27. Weekly issues may be expected in future if the members of the Association will lend their assistance to the Chairman by contributing material so that the whole labor of preparation may not fall upon him alone.

The Bulletin material should be considered as confidential by members of the Association, excepting where it may be thought desirable by the Association to permit the republication of special communications in the technical journals, or in the daily press.

There could be no possible objection to the re-publication of historical material like Lieut. Selfridge's paper in Bulletin No.II, or the Associated Press Dispatches sent by members. In fact most of the Bulletin material could be freely offered to the Public without injury to the Association.

Communications, however, relating to the future work of the Association, or of its members, and statements of inventions 4 2 or discoveries by members, should be considered as strictly confidential unless otherwise decided upon by vote of the Association. Mr. Curtiss's plans for an improved motor, for example, which appeared in the first Bulletin, may perhaps give rise to a patented invention by Mr. Curtiss. The interests of Mr. Curtiss, and of the Association, therefore demand that the article in question should not be given to the general public at the present time: and so also with other papers of similar character.

Discretional power should be given to the Secretary to permit the re-publication of material from the Bulletins. He should report to the Association from time to time what permits he has issued and obtain the formal approval of the Association in order to relieve him from personal responsibility.

Re-publications should contain a statement to the effect that the articles in question have been copied from the Bulletins of the A.E.A. “by permission of the Association”.

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NOTES .

Patent Examination: — After making a thorough examination of aerodrome No. 3, “Curtiss's June Bug” at Hammondsport, N.Y., Mr. Cameron reports that he believes there are several patentable features about the apparatus. Messrs. Mauro, Cameron, Lewis & Massie have therefore been requested to make a preliminary examination of existing patents to ascertain whether the details that are believed to be patentable are novel A.G.B.

Co-operative Work :— Work upon aerodrome Nos. 4, and 5 is being carried on simultaneously at Hammondsport and Beinn Bhreagh, and the official headquarters of the A.E.A. remains at Hammondsport for the present.

Messrs. Curtiss and Selfridge are at Hammondsport where they will give their personal assistance to Mr. McCurdy in developing his plans for aerodrome No. 4. Messrs. Bell and Baldwin are at Beinn Bhreagh and they will give their assistance to Mr. McCurdy by correspondence.

Mr. Baldwin at Beinn Bhreagh will give his personal assistance to Dr. Bell in carrying out his plans for a tetrahedral aerodrome which will be No. 5; and Messrs. Curtiss and Selfridge and McCurdy will give Dr. Bell their assistance by correspondence.A.G.B.

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WORK OF THE AERIAL EXPERIMENT ASSOCIATION. As recorded in telegrams sent by members of the A.E.A.

To Charles T. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., June 25, 1908 —Last night at about 8 P.M., Mr. Curtiss made two short flights. Owing to a strong side wind the machine was found to make considerable lee-way though with no tendency to tip. The fields in which the tests are being conducted is somewhat restricted by various obstacles except in one part. In order to clear these the machine must rise to a greater height than the experimenters deem prudent at this time, and as the drift caused by the machine necessitated flying over instead of around these obstacles, the tests were postponed till this morning.

At 6 A.M. Mr. Curtiss made a beautiful flight of 725 yards in 41 seconds at the rate of 36.2 m per hour, running before a wind that varied between 6 and 8 miles an hour. The machine tipped sharply to port shortly after getting in the air, but was righted immediately be means of the tip controls, and kept on an even keel from then till the end of the flight.

The surfaces had been revarnished and made completely air-tight since the last long flight. This increased the efficiency of the apparatus to such an extent that the motor developed too much power even with the spark fully retar ? d ed. Mr. Curtiss finally had to move his weight forward to aid the front control and keep the machine from climbing despite of this he reached a maximum height of 40 feet.

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2 Owing to this difficulty, Mr. Curtiss decided to discontinue his flight. This he did by shutting off the engine and gliding to the ground. No damage was sustained and the Aerial Experiment Association hope to try out the machine again this afternoon after the necessary alterations have been completed. This has been by far the most successful of all the flights to date.

(Signed) T. Selfridge.

To Charles T. Thompson, Supt. Associated Press, N.Y.,

Hammondsport, N.Y., June 25, 1908 —G. H. Curtiss in his “June Bug” aerodrome No. 3, of the Aerial Experiment Association flew 1140 yards, 3420 feet in 60 seconds this evening about 7.30 P.M. The flight was stopped on account of the trees and a fence which limit the practice ? g round. This performance is the most remarkable on record, being only the seventh flight of the machine and the eight attempt by the aviator. The controls worked perfectly in every respect, the machine having to travel on the arc of a circle to be able to make this distance owing to the limits of the field. The height varied from 3 to 20 feet.

The Aerial Experiment Association has just telephoned the Aero Club of America that it is now ready to try for the Scientific American Cup which is to be given to the machine that officially flies the distance of one kilometer in a straight line. This distance was surpassed to-night by 46 yards.

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3 All credit is due to the marvellously efficient eight cylinder Curtiss air-cooled motor which has never given the slightest difficulty and to the wonderful aptitude shown by the aviator Mr. Curtiss. There were several hundre ? d spectators.

(Signed) T. Selfridge.

To Charles T. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., June 27, 1908 —Mr. Curtiss again made two very successful flights here to-day of 400 yards in 24 seconds and 540 yards in 33 seconds at the rates of 34 and 33 miles per hour respectively. These flights were terminated at the will of the operator at a smooth place in the field in order to avoid running the machine back through the standing grain at the further end of the grounds. Their object was to test the efficiency of some alterations which had been decided upon. They proved all that had been expected and the machine is under better control than ever. It is hoped that the cup committee of the Aero Club will be able to come to Hammondsport as soon as possible as the Aerial Experiment Association has now been ready for it for the last three days. The Curtiss motor worked very satisfactorily.

(Signed)T. Selfridge.

To Charles T. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., July 3, 1908 — The Aerial Experiment Association's aerodrome No. 3, G. H. Curtiss aviator, made a flight of ¾ of a mile here this evening in 68 # seconds at 38 miles an hour. The machine traveled in a sem - i -circle.

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4 The flight was one of several that were made in pre-aration for the official test of the machine which is to take place to-morrow before the Contest Committee of the Aero Club of America for the Scientific American Trophy.

(Signed) T. Selfridge.

To Charles T. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., July 4, 1908 — The Aerial Experiment Association's Aerodrome No. 3, Curtiss' "June Bug" to-day earned the right to have its name the first inscribed on the Scientific American Trophy, by making an official flight of 1 kilometer in a straight line measured from ?? th e point where it left the ground. After passing the flag marking the finish, the machine flew 600 yards further and landed at the extreme edge of the field near the railroad track, after crossing three fences and describing the le t ter S, 2000 yards in all in 1 minute 42 ½ seonds at a speed of 39 miles per hour. This followed a 900 yard flight in 56 seco l n ds.

The machine never behaved better and the long flight could have been continued at the will of the operator had he cared to rise over the trees which bounded the field. Though quite possible it was not deemed wise to attempt it at present stage of the aviator's development. There was hardly a breath of air starting during either flight. This trial is really of the utmost importance as it is the first official test of an aeroplane ever made in America and there are only two other machines which have traveled further in public; 10 5 Farman's and Delagrange's. The Wrights though have undoubtedly far outflown it in private so that America is not so very far behind France as might be supposed. The last flight to-day was the 15th made by the machine, all having occurred under far more adverse conditions than those encountered by the French machines.

It is hoped that there will be several other names on the cup before the new year. In order to possess it, this trophy must be won at least once in three separate years. The rules being changed and made more severe after each trial. It is always i o pen for competition upon due notification being made to the Contest Committee of the Aero Club of America to whom it was presented by the Scientific American in the Spring of 1907.

There are about 1000 witnesses among them being Messrs. Hawley, Post, Herring, Manley, Guy and Beach of the Aero Club.

(Signed) T. Selfridge.

To Charles T. Thompson, Supt. Associated Press, N.Y.

Hammondsport, N.Y., July 5, 1908 —Before the departure of the judges and Aero Club Committee to-night, G. H. Curtiss before a crowd of several thousand people made an ascension in the June Bug and for the first time in the series of trials made a turn and faced directly toward the starting point. After covering # of a mile toward the starting point, it was necessary to fly over a vineyard and fearing disaster owing to the fact that he was flying low he brought the machine down with slight damage to the front control right wing. Mr.

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6 The flight and the maneuvers were considered a great success, it being the first attempt to describe a circle. The members of the Aero Club Committee expressed great satisfaction at the outcome of this trial. The aerodrome will be repaired to-night and experiments will he continued to-morrow. A number of the New York and Washington parties remained for the events to-morrow.

(Signed) T. Selfridge.

OTHER TELEGRAMS .

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., July 9, 1908 — Mr. Cameron came yesterday. Made half mile flight for him last night. He finds several patentable features.

(Signed) G. H. Curtiss.

To DR. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., July 9, 1908 — Mr. Cameron here for few days. Thinks we have severable patentable features. Had flight last night three-quarters of a mile. Its becoming an old story now. Will attempt complete circle to-night coming back to starting point.

(Signed) J.A.D. McCurdy.

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7 To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., July 10, 1908 — Made short flight to-night — distance one mile. Attempted to turn and land at starting point, but valley proved too narrow to accomplish this feat as yet.

(Signed) J.A.D. McCurdy.

LETTER FROM MR. G.H. CURTISS.

Hammondsport, N.Y., July 11, 1908 — I enclose a description of the “June Bug”, especially its differences from the “White Wing”, and the eight sets of prints — also the table of the eighteen flights I have made showing the distance covered, time, cause of stopping, etc.

(Note:—The description of the “June Bug” will appear in a subsequent issue of the Bulletin. The table of eighteen flights is appended below, A.G.B).

*** We have number 4 well under way. We have some good improvements in sockets for the struts and turn-buckles. The running gear seems to be pretty good — we have not broken it, although we have broken the front wheel twice. These were my only two bad landings. Made a mile flight last night, going around the hickory tree in the lower hayfield.

As I wired you, Mr. Cameron was here and found a number of patentable features, including the tip controls, three wheel running gear, the combination steering of the ground wheel and rudder, and the shoulder movement which controls the wing tips. He has taken the data back to

(Signed) G.H. Curtiss.

AERODROME NO. 3, CURTISS'S JUNE BUG.

18 Flights by G.H. Curtiss.

No.	Date	Dist. in yds.	Time in Sec.	Cause of stop	Breakage.
1	June 21	152	11.0	Aviator's lack of skill	None
2	June 21	139	9.0	Aviator's lack of skill	None
3	June 21	422	25.5	Voluntary	None
4	June 24	40	3.0	Too much wind	None
5	June 24	100	6.0	Too much wind	None
6	June 25	725	41.0	Voluntary	None
7	June 25	1140	60.0	Boundary of field reached	None
8	June 27	400	24.0	Voluntary	None
9	June 27	540	33.0	Voluntary	None
10	July 2	30	2.5	Too much wind	None
11	July 2	150	14.0	Voluntary	None
12	July 3	30	2.5	Voluntary	One wheel & wing broken
13	July 3	1300	68.5	Boundary of field reached	None
14	July 4	900	56.5	Wrong tail adjustment	None
15	July 4	2000	102.5	Stopped to avoid tress & railroad	None
16	July 5	1500	75.0	Too short turn attempted	Front wheel & few struts broken
17	July 8	800	41.0	Voluntary	None
18	July 10	1760	90.0	Made complete turn	None

LETTER FROM MR. G. H. CURTISS.

Hammondsport, N.Y., July 14, 1908 :—I thank you very much for your letter of July 5th. I am greatly pleased myself that we were successful in accomplishing what we set out to do. I am satisfied that our machine is equal, if not superior, to any of the foreigners. I note in Mr. Farman's contract that he specifies absolutely smooth fields, with no fences, or ditches and with grass cropped short. We have been working at a considerable disadvantage in this respect so that if we can fly a mile at a time, picking our way as we do, we could surely make a good showing over a perfect course where landing could be effected anywhere.

I am glad that we are to build another machine as it will give us a chance to try out the twin propellers which we wanted to use on the No. 3, but which was given up to avoid delay. The twin propellers are what should be used on the tetrahedral where the greatest obtainable thrust will be needed.***

(Signed) G.H. Curtiss. (Above letter was addressed to Mrs. Bell).

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PLANS FOR AEORODROME NO. 4: by J.A.D. McCurdy.

Extract from letter to Dr. Bell.

Hammondsport, N.Y., July 17, 1908: —As regards the new machine: It was demonstrated so clearly in the June Bug that non-porous cloth was so important that we have decided to cover our frames with the material used by Captain Baldwind for his balloon in the Government contract. He is making up a special order for us which will be absolutely airproof, and very light.

Mr. Curtiss thinks from his flights that the tip controls are not sensitive enough, and so we are planning to give the machine greater lateral extension than in former cases.

The front control will also be further out, about 15 feet from the front edge of the plane.

We are also doing away with those jack-joints and using turn-buckles on every wire so that we can adjust each separately.

We think that perhaps the surfaces ought to have an angle of incidence of 9 degrees instead of 7 ½ degrees or 8 degrees, as in former cases. However, the point is not decided upon yet.

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WINNING THE SCIENTIFIC AMERICAN TROPHY JULY 4, 1908: by Mrs. David G. Fairchild.

Extract from a personal letter to Dr. Bell from his daughter Mrs. Fairchild.

***In spite of all I had read and heard, and all the photographs I had seen, the actual sight of a man flying past me through the air was thrilling to a degree that I can't express.

We all lost our heads and David shouted, and I cried, and everyone cheered and clapped, and engines tooted. Mr. Post was there, and Mr. Hawley, Vice-President of the Aero Club. Mr. Herring and his sister, Mr. and Mrs. Manley, Captain Baldwin, Mr. Lake of Sub-marine interests, Mr. Guy, Mr. Mott, Mr. Jones, Mr. Lyon, and Mr. B— a very nasty, grumpy individual who, however, was not able to interfere with any ones enthusiasm.

The banks were crowded with spectators but the flights on the 4th for the trophy were not as well attended as the one on the 5th as the weather was so uncertain. It showered and blew at intervals all day until about seven, when it cleared and ideal flying conditions prevailed. Before that the time was taken up with measuring off the course. No very pleasant task through wet meadow, ploughed potatoe patch and swamps. David started off immaculate in his white clothes and came back a sorry sight. All sorts of pictures were taken too, and the air was full of the click click of shutters. There were moving picture cameras and kodaks of all sizes from David's baby to eight by tens.

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2 At the first flight I was at the corner of the vineyard nearest the road with Douglas, and David was at the starting line. The machine rose beautifully and flew by us but didn't quite make the kilometer. It was flying pretty high and Mr. Curtiss wanted to bring her down a little but she didn't answer her control quickly, and when he got her down he could not get her up again. Nothing was hurt, however, and all hands towed her back to the starting point for the second flight. David and Mrs. Curtiss, and I chose our stand on an old log at the far side of the potatoe patch. The first flight had raised excitement to boiling point, and as Mr. Curtiss flew over the red flag that marked the finish and way on towards the trees, I don't think any of us quite knew what we were doing. One lady was so absorbed as not to hear a coming train and was struck by the engine and had two ribs broken.

Mr. Mason took me right in town to telegraph the glad news to you, and it was about half past nine when the last of the party straggled in.***

***Mr. H—was especially enthusiastic over tetrahedral construction which he believes is going to be a great feature in flying machines. He has promised to call us up over the long distance telephone to invite us to his preliminary flights at Atlantic City. It was interesting to hear the opinions about him. Mr. Curtiss says he's the authority on all kinds of aeroplanes, but they all without exception (the ones I talked to) were uncertain as to whether he is a genius or a fool. They are reserving judgment till after the 18 3 Fort Myer trials.

On Sunday the town gave us a boat ride and lunch, and on our arrival in town the band turned out to greet Mr. Curtiss and the boys carried him ashore on their shoulders.

About seven that evening there was another beautiful flight, though Mr. Curtiss was not able to come back to the starting point as he had hoped. He circled, but the machine, as I understand, slid off on the air and he landed with a broken tip and bent wheel.

(The above letter was dated July 6, 1908, A.G.B.).

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WINNING THE SCIENTIFIC AMERICAN TROPHY JULY 4, 1908:— by G. H. Curtiss.

Extract from letter to Dr. Bell dated Hammondsport, July 7, 1908.

The affair of July fourth went off very nicely. There seemed to be some question, especially with the — representatives if we could fly the kilometer; and when we fell short on the first trial, Mr. B—who represented the — seemed to be pleased rather than disappointed.

The machine was not flying as it should, and we discovered that the tail, which had been attached and detached a great many times, had gotten into a slightly negative angle which made it necessary to depress the forward plane to keep the machine on an even keel. This so greatly increased the resistance, that when it became necessary to slow the engine to prevent going too high the speed was slackened to such an extent that landing was necessary. In this trial, about half a mile was covered.

After making the adjustment of the tail, she flew like a real June Bug; and just on account of Mr. B—, who was standing at the finish with a camera to photograph the machine in case I fell short on the distance, I flew the machine as far as the field would permit, regardless of fences, ditches, etc.

We gave the Committee and Aero Club members a little outing on the Lake Sunday with the local band in attendance.

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WINNING THE SCIENTIFIC AMERICAN TROPHY JULY 4, 1908:— by J.A.D. McCurdy.

Extract from letter to Mrs. Bell dated Hammondsport, July 8, 1908.

It was a dark day and the papers predicted rain, and it certainly did rain all through the morning, but towards three or four o'clock showed signs of clearing up.

The p P leasant-Wine-cellar people kindly threw open their doors to us and our visitors, and prepared a sumptuous lunch as one means of passing the dreary hours of waiting. Everybody was just as nice as they could be, and the crowd was most patient and sympathetic.

About six the time seemed propitious, and the machine brought out of the tent, and the tail attached, the motor run, and everything carefully looked over. Manley measured the course in a straight line running right through the vineyard. Mr. Curtiss took his seat and the machine was rolled round to its starting point.

After a few moments the motor was started, and the signal given to let go, amid a breathless silence on the part of the crowd. The June Bug sped down the track, and made a beautiful start, flew well, but short about four or five hundred yards. No damage was done however, so she was brought back and carefully looked over.

This time we changed the angle of incidence of the tail slightly, making it more positive, we also re-wired the front-control. This time everything went serenely and not only did the June Bug reach the flags which marked the 21 2 finish, but, amid the rush and cheering of the throng flew six hundred yards or more further, to the limit of the field and made a beautiful landing on a smooth spot, absolutely unhurt in every respect. Everybody was almost crazy, and even Mr. H— appreciated the effort of the A.E.A. to fly.

The town did all in their power to entertain our guests, and they all w ?? er e delighted with their visit, and went back to New York with very happy tho g u ghts of the visit which they will have every cause to remember.

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WORK OF BEINN BREAGH LABORATORY:— Report by Wm. F. Bedwin, Supt.

Since my report of July 13 in Bulletin No. 1, we have been steadily engaged at the Laboratory on the following work:—

Carrying along construction of the new catamaran structure, the two boats for which are all finished and set up in place with the deck-timbers on them and nearly ready for the decking. The present condition (July 23) is shown in the accompanying photograph.

Have finished the one hundred 50 cm triangles.

Have put, in the three kites A, B, C, mentioned in last report, a set of guy wires on the keel stick at a point 50 cm back from front edge of kite extending to ridge pole. Have also made attachment points on keel stick every 25 cm from the end of the bow, so that flying line can be readily shifted to any desired point from the extreme bow to a point 50 cm back on kite.

Experiments have been made at the Laboratory on the following dates:—

1908, July 7, Ring-Kite tried (See Bulletin No. 1).

1908, July 10, Final experiments with Ring-Kite. Kites A,B, and C tried. A number of anemometer readings were taken. Wind Velocity: Ten observations.

1908, July 11, Flew kites A,B, and C separately and together; also took readings of anemometer, inclinometer and dynamometer. Wind velocity 11 observations; angular altitude 30 observations; pull 96 observations; total 137 observations.

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2 We also tried the empty Frost-King kite photographs of which appeared in Bulletin No. 1.

1908, July 16, Experiments made with a gyrostat. Flew kite A observing indications of anemometer, inclinometer, and dynamometer. Wind velocity four observations; angular altitude 10 observations; pull ten observations. Total 24 observations.

1908, July 17 Made four complete series of experiments with kites A and B. 8 series altogether. Anemometer, inclinometer, and dynamometer read simultaneously. Wind velocity 29 observations; angular altitude 80 observations; pull 80 observations; total 189 observations.

We have men at work making aluminum castings for tetrahedral cells.

We have repaired and ready a small pilot kite of the Frost-King form for general purposes. 12 cells on top, 6 cells high, and 6 cells deep. Total 182 cells full construction.

We have moved the dark room up to the Western side of Annex and fitted it up with water supply, and also put on a large veranda on which to do our printing.

In connection with our photo department we have made a new dating board with letters and figures painted on pieces of tin which can be slipped in and out of a groove in the board. So far as possible the dating board will be photographed on the same plate or film with the apparatus or experiment illustrated so as to preserve the date of the photograph on the film itself.

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3 The use of the dating board will be observed on the accompanying photograph illustrating the catamaran structure. It shows the date upon which the photograph was taken.

We have made and filed three copies of photos of work done to the number of 42; and have also made a large number of blue prints for Bulletins and other purposes. We are making a printing-frame large enough to take the plans of the Cygnet, Red Wing, and others of which we want blue prints.

In connection with work done last winter would say that we saved about two hundred dollars worth of silk from the wreck of the Cygnet at a cost of twelve dollars to us. This is a very low price for the work involved, and I am advised by the contractors that it could not be done again for the same money.

On July 13 there arrived at Beinn Bhreagh the auxiliary boat “Pomiuk” with party of Yale Students on board, who are taking boat down to Dr. Grenfell at Labrador. At Dr. Bell's request, we went on board to try and help them with their engine, which they could not get to run. We took engine partly to pieces and made several new joints, and tightened and cleaned things up generally, and succeeded in getting engine to run very satisfactorily for them. The engine is a two cylinder 15 H.P. Meiter-Weitz kerosene fuel made in New York. We gave the ship a good supply of Beinn Bhreagh water, and all the assistance we could; and they sailed on the 15th at noon for Battle Harbor.

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SPECIFICATION OF RING-KITE: by Wm. F. Bedwin.

As used July 7, 1908.

As shown in accompanying drawings kite is made of tetrahedral cells and surfaces are separated the vertical height that two 25 cm cells make.

The outer line of cells is made with regular 25 cm cells; and the inner line is of cells 25 cm on all sides, except the cross-sticks that connect inner points of outer line of cells: These sticks are only 22.4 cm long.

The upper and lower planes are made separately and false triangles are put on to connect the free points of cells, and then the planes are connected together by tying at junction points with string, making an X cross-section as shown. Around the inner and outer corners is placed a small angle beading making a continuous corner to glue surface to. The silk surface is next put on both the upper and lower planes, and is fastened to the light beading with glue, and is also caught up with thread at the center points of cells. A heavy beading is then run round on all four corners as shown in the X section, and tied well every 25 cm to the inner small beading.

A keel stick is tied on at any point as shown, projecting a short distance both inside and outside the lower plane. Four braces placed diagonally running from upper to lower surface are then put on at the section where the keel stick is placed.

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2 Same specification as above applies to the Ring-Kite as used July 10, 1908 with the following changes:—

The diagonal bracing is carried all the way around the kite on both the inside and outside faces; and the heavy beading is put on the outer upper and lower corners only.

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EXPERIMENT # 1 PLAN OUTSIDE FACE SECTION

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EXPERIMENT # 2 PLAN OUTSIDE FACE INSIDE FACE SECTION

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FINAL EXPERIMENTS WITH THE RING-KITE JULY 10, 1908: by Alexander Graham Bell

After the experiment with the Ring-Kite, July 7, 1908, noted in Bulletin No. 1, the kite was strengthened by beading connecting the lower and upper aeroplanes. To offset this additional weight the inner rings of beading on the two aeroplanes were removed, with the net result that the kite was lighter as well as stronger than before. For details of construction see Mr. Bedwin's article in this Bulletin.

The Ring-Kite in its improved condition was tried July 10, 1908. The wind velocity during the experiment was not noted, but later in the afternoon when the wind conditions had not materially changed ten readings of the anemometer were taken yielding a mean result of 10.72 miles per hour.

The Ring-Kite, with the flying line attached to the front edge of the lower aeroplane, rose very steadily and gracefully into the air. Two photographs of the kite in the air are appended in illustration. One of these was taken July 7, the other July 10. No measurements of angular altitude, or pull were made. The flying line was held in the hand instead of being attached to a cleat, because it was found that the pull was slight, inspite of the size of the kite, and the fact that there was considerable wind. At its highest elevation the kite seemed to fly very steadily although a slight swaying motion was observed. There was nothing remarkable about this, however, as the wind was constantly fluctuating in strength. Upon the whole the behavior of the kite 31 2 in the air was satisfactory, and it was brought down easily and gently, by over-running the flying line, without any injury to the structure.

The point of attachment of the flying line was then changed. It was fastened to a bridle attached to the front and rear edges of the front aeroplane so that it came practically midway between them. The kite then rose to a higher elevation than before, but did not fly so steadily. The swaying motion formerly observed was greatly increased, and the kite moved about from side to side like a bear pacing backwards and forwards in his cage.

During one of these oscillations the kite slid off the wid to one side and began to fall edgeways towards the ground. The strain on the flying line was immediately relaxed but the kite showed no signs of recovering its equilibrium. It continued to slide down hill, almost in a straigth line, until it struck the ground. Its side was crushed in by the impact, and the experiment — and the kite — came to an end. A photograph of the kite falling through the air is appended.

Conclusions .

This disaster only confirms the impression left by numerous experiments with other forms of kite, that horizontal aeroplanes without vertical surfaces or their equivalent to steady them, are essentially unstable in the air, and are liable at unexpected moments to slide off to one side and come down edgeways to the ground. The Red Wing and White Wing both came to an end in this way; and it should be recognized that aeroplanes of this character constitute a 32 3 dangerous feature in an aerodrome.

It is somewhat remarkable that the Ring-Kite showed no tendency to right itself when released from the strain of the flying line. We know it would have done so had there been no upper aeroplane.

With the lower aeroplane alone and the empty framework above it, without any upper aeroplane at all, we would have had conditions comparable to those existing in the gliding models with whose antics in the air we have become familiar.

From our past experiments with these models we know that a single aeroplane with its supporting framework above it, always steers itself up when thrown edgeways down hill, its pathway gradually forming an ascending curve: Whereas an aeroplane with its framework below it, slides down hill in a descending curve. In the case of the Ring-Kite the path pursued in falling formed almost a straight line, there being very little indication of a curvilinear path, and there was certainly no tendency to a recovery of position. The altitude reached when the sliding movement began was quite sufficient to have developed a sensible curve had there been any marked tendency to deviate from a rectilinear path, but there was very little indication of deflection, and certainly none in the upward direction.

The flying line was 100 meters long, and when the sliding began, the kite was probably at an altitude of about 30 meters in the air.

It is probable that in this case the tendency of the empty framework to steer the lower aeroplane up when the 33 4 kite dived to one side, was neutralized by an equal tendency of the framework to steer the upper aeroplane down. This has an important bearing upon the behavior of aerodromes with superposed aeroplanes under similar circumstances.

A single aeroplane, or “monoplane”, usually consists of a surface stretched upon some sort of framework, so that the framework appears on one side of the aeroplane only. When projected edgeways through the air such an aeroplane does not pursue a rectilinear path, for its motion is constantly deflected to one side; and the direction of the deflection is towards the framework-side of the aeroplane.

It may be that the deflection is caused by the resistance of the framework to the air, which would make it act like a runder to steer the aeroplane to that side. Other causes may also be present, such as a difference of atmospheric pressure on the two sides of the aeroplane. What ever may be the true cause however, the effect is there , and in unmistakable form.

It would be well then is aerodromes of the monoplane class to place the aeroplanes below the frameworks upon which they are stretched, thus imparting to them a tendency to rise when propelled; rather than place the surfaces above the frameworks, which would give them a tendency to dive.

Monoplanes with their supporting frames above them, possess one important advantage over superposed aeroplanes with the framework between:— Upon sliding down hill they will slide up again after a while ! Whereas there seems to be little if any tendency to recovery in the case of superposed under similar circumstances. This at least is 34 5 one of the conclusions suggested by the fate of the Ring-Kite and the first two aerodromes of the Aerial Experiment Association.

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20 Taken 1908 July 10 th De?. 1908 July 11 th .

36

27. Taken July ?? th De?. 1908 July 11 th .

37

ON THE GYROSCOPIC ACTION OF PROPELLERS: by Alexander Graham Bell.

In the course of a discussion with Mr. J. A. D. McCurdy last May concerning the nature of the torque produced in an aerodrome by the rotation of its propellers, Mr. McCurdy refeered to Brennan's Mono-Rail Car System as an illustration of the powerful gyroscopic action of fly wheels. This led to the consideration of the gyroscopic action of propellers; and we consulted the Encyclopedia Britannica, Vol. XI, p. 352 to see wh e ther we could work out, from the descroption of the gyroscope there given, what would be the effect upon an aerodrome of the gyroscopic action of its propeller, and we came to the following theoretical conclusions.

With a right handed rotation of the propeller the machine, when steered to the left or port side, would tend to rise at the bow until the bow pointed vertically upward. When steered to the right, or starboard side, the machine would tend to dive until the bow pointed vertically downwards.

With a left handed rotation of the propeller opposite effects would be produced; the machine tending to dive when turned to port, and tending to rise at the bow when turned to starboard.

The general conclusion reached was that both the horizontal and vertical steering of an aerodrome with a single propeller would be seriously affected if the propeller exerted any sensible gyroscopic action.

This theoretical result has been amply verified by experi e ments made here July 16, 1908, with a gyrostat constructed after the plans of the late Lord Kelvin.

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2 The gyrostat consists simply of a thin metallic case enclosing a heavy wheel which can be set in rapid rotation by means of a string coiled round one end of the axis.

In order to imitate the action of the propeller of the June Bug the concealed wheel was given a left handed rotation (against the hand of a watch). I then held the gyrostat in my hand with one axis pointing forward, so that considering this end of the axis as the bow or front end of an aerodrome the wheel represented the propeller. Then to represent the forward flight of the aerodrome I walked forwards with the gyrostat in my hand. I then imitated the action of steering the aerodrome by turning to the right. Instantly the bow end of the gyrostat turned upwards with considerable force. Upon turning to the left it turned downwards. Then to represent the act of steering downwards with an aerodrome, I depressed the bow end of the gyrostat with the result that the bow tried also to move to the right or starboard side. Upon elevating the bow of the gyrostat to represent steering upwards with an aerodrome, the bow of the gyrostat was de ?e fl cted to the left.

With a right handed rotation of the wheel of the gyrostat opposite effects were produced.

The effects were so marked as to indic ate that the gyroscopic action of a rapidly rotating propeller in an aerodrome should be studied and allowed for in the steering of the apparatus. The following contains a summary of the observations made:— 39

GYROSCOPIC ACTION OF A PROPELLER. (Summary of Observations)

Right Handed rotation .

Steering to right sends bow down.

Steering to left sends bow up.

Steering down sends bow to left.

Steering up sends bow to right.

Left Handed Rotation .

Steering to right sends bow up.

Steering to left sends bow down.

Steering down sends bow to right.

Steering up sends bow to left.

40

AERODROME TRUSSING: by F.W. Baldwin.

A radical difference in function between a bridge and an aeroplane truss has apparently been largely if not quite lost sight of by those who have copied bridge designs and applied them without modification to aeroplanes.

In the first place a bridge is not built to be driven through the air. It is not particularly designed to offer as little resistance as possible to the wind. Lightness and strength, in other words economy of material, is the criterion of bridge design.

Not so with the aeroplane truss however, In this, one truss may be heavier than another, of equal strength, and yet be much more desirable. From data well established experimentally, we know that it is of prime importance to give what is known as a “fair form” to all parts of an aerodrome. It is obviously an advantage then to left each member of a truss be deep from fore to aft and narrow sideways.

If a strut of this cross-section be subjected to compression it is obviously weak one way, and superfluously strong the other. Having a greater moment of inertia about a lateral than a fore and aft axis, it will buckle laterally long before its strength is taxed in a fore and aft direction.

In bridge design economy is obtained with symmetrical compression members, but in aeroplane work it should be obtained with members of un-symmetrical cross-section, and this alone calls for an entirely new system from that employed in bridges.

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2 To secure compression members against this deflection is then the problem with which we are confronted.

Take for example the simple Pratt truss (Fig. 1) which has been very generally used as an aeroplane truss. This with its long unsupported vertical posts would seem to be a poor form to build, if we are to make it of material fish-shaped in cross-sect ? i on.

The Howe truss (Fig. 2) has one great advantage over the Pratt:– It has no long unsupported compression-members. The diagonals, which are the compression-members, intersect, and thus afford support against lateral deflection in the planes in which it is needed.

The Howe truss, however, has a greater aggregate length of compression-members than the Pratt, and this is clearly disadvantageous.

For this reason then, if we adopt the general form of truss with upright compression-members, the problem resolves itself into one of securing these vertical posts against lateral deflection. This can be done in a variety of ways.

First of all struts can be run across the truss horizontally supporting the vertical posts at their centers. These struts could be themselves supported at their central points by the diagonals, and a very rigid construction obtained (Fig. 3).

The introduction of more compression-members is to be avoided, however, as these offer greater resistance than do the comparatively fine wires that can be safely used to 42 3 take up tension. A more economical bracing which would give the same support at the central points of the vertical posts can be obtained by a horizontal tie-wire branched at the outside panel to the upper and lower cords of the truss (Fig. 4).

Another way to obtain excellent lateral support for the uprights could be secured by the diagonals being of the double inter-section type (Fig. 5), or even triple intersection might be used to advantage.

The bow-string method by which lateral support was given the vertical s in the Red Wing truss has been described elsewhere (paper read May 17, 1908, which will appear in a forthcoming Bulletin), and attention need only be drawn to the fact that it has proved a wonderfully efficient truss of no great weight and of low head resistance (Fig. 6).

The Tetrahedral truss affords perhaps the greatest opportunity of all to embody this principle of lateral bracing. If large cells are used they can be easily braced to give a very rigid truss with fish-shaped material so thin as to reduce enormously the head resistance of the whole structure (Fig. 7).

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Fig. I

Fig. II

Fig. III

Fig. IV

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Fig V

Fig VI

Fig. VII

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IMPROVEMENT IN THE METHOD OF CALCULATING WIND VELOCITY: By F. W. Baldwin.

Take the reading of the anemometer in feet for 68 seconds. Move the decimal point two places to the left, and the result will be miles per hour correct to one decimal place.

Example: 1007 feet in 68 seconds or 10.07 miles per hour. The correct answer to one decimal place is 10.1 miles per hour.

THE RUDIMENTARY WINGS OF FLIES AND THEIR SIGNIFICANCE: By A. G. Bell.

Few people, excepting entomologists, are aware of the fact that flies, and other two-winged insects, possess another undeveloped pair of wings behind the first, known as “balancing organs”. The presence of these rudimentary organs shows that the two-winged insects (diptera) are descended from a four-winged form.

Does this indicate that two wings are preferable to four for the purposes of flight?

46

REPORT UPON FRENCH MOTORS: by W. Rupert Turnbull.

Letter to Dr. Bell.

R.M.S. Empress of India, June 30, 1908: — I am just returning from a trip to Europe where I saw and heard much of interest in aeronautic matters. In accordance with my promise of last October I will try to give you a few notes on French Aeronautic Engines.

I had an interesting talk with Farman, and he told me that he did not use any radiator with his water-cooled “Antoinette”, but simply carried a small quantity of water in the water-jackets etc., and allowed this to boil away, thus his runs were necessarily short.

He is not finishing his “flying-fish” at present, simply because there is no really satisfactory engine on the French market, apparently all the French motors (particularly the air-cooled ones) give their rated horse-power only for about ten minutes, and then the H.P. rapidly falls off as the engine over heats.

I did not investigate the “Penault” engine, but I do not think Farman found it as satisfactory as the “Antoinette”

Farman seems to think that the “Pelterie” is the best of the air-cooled engines and certainly the principle, as far as cooling goes, is rather pretty, but I visited the factory and it struck me that the engine was too complicated and delicate.

The “Farcot” engine (from the catalogue) is something like the “Penault”, but I doubt if Farcot has the capital or fecilities for making the engine he advertizes and I do not 47 think it would be safe to order from him.

In my opinion the best aeronautic engine I saw was the Duteil and Chalmers (81 Ave d'Italie, Paris). They have patented a system of cooling, which seems to me promising. Their copper-jackets surround the cylinders, and the gasoline vapor (on its way to the combustion chamber) is passed through these, and thus keeps the cylinders cool enough. They also make air-cooled cylinders, but seem more ready to give a guarantee on the vapor-cooled type. My only objection to their engines is that they only have two cylinders (opposed), but the makers claim the engines are perfectly balanced and run without vibration.

If you decide to order any French engines, of any make I would strongly advise that they be made on a strict contract requiring a certain guaranteed brake horse-power delivered continuously for not less than half an hour, and at a certain weight, including all accessories.

With kind regards to your associates, I am

Sincerely yours, (Signed) W. Rupert Turnbull. Rothesay, N.B.

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ASSOCIATION'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

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Beinn Bhreagh, Near Baddeck, Nova Scotia .

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EXPERIMENTS WITH KITES, A,B & C, 1908, July 11: by A. G. Bell.

Preliminary Remarks : Experiments with Kites, A,B & C are being pushed at Beinn Bhreagh as rapidly as wind conditions permit, as it is hoped that the results may be used in determining the arrangement of cells in the tetrahedral aerodrome No. 5. Some details concerning these kites have already been given in preceding Bulletins (I, 30,31,34,35,36; III, 22,23).

The Kites A,B& are alike in external shape and cross-section, the differences being internal (Fig.1,Fig.2).

Kite A is of full tetrahedral construction, and is composed of four hundred and eight winged cells with simple beading. This kite is considered as the standard with which the others are to be compared (see Bulletin I,34).

Kite B is also composed of four hundred and eight cells but there are no silk surfaces on the rear and internal cells, a mere shell of winged cells being retained on the front face, bottom, and sides. Total:— 253 winged cells, 155 empty cells, beading the same as in Kite A (see photograph Bulletin I,35).

Kite C is built in three sections. Each section is of full tetrahedral construction; but, from the manner of attaching the sections together, a hollow space, triangular in cross-section, appears between them running right through the middle of the kite from one side to the other. Total 340 winged cells, no empty frames. The Beading differs from that in Kites A & B by a horizontal strip running from side to side along the middle of the front and rear faces; and by beading on the 4

Fig. 1 Front View

Fig. 2 Side View

Fig. 3

Fig. 4

Fig. 5

5 2 bottom of the upper section running from fore to aft (see photograph in Bulletin I, 36).

The keel stick for the attachment of the flying lines is 300 cm long. That part of the keel stick directly under the ridge pole is taken as the point of origin from which to measure the places of attachment of the flying lines. Distances forwards from that point are considered as plus , distances backwards as minus (Fig.3).

The flying lines are each 100 meters long. The main line, of one-quarter-inch Manilla rope, weighs 5121 gms. The bow-line, of stout cord, weighs 507 gms.

In experiments, 1908 July 11, the main-line was attached 75 cm in advance of the central or zero point of the keel-stick (25 cm behind the front edge of the kite structure); and the bow-line 200 cm from the zero point (or 100 cm beyond the front edge of the kite structure). The experiments were made with main-line tight, bow-line slack (Fig.4).

In experiments 1908 July 16 and 17, the points of attachment for the flying-lines were respectively:— main-line 50 cm, bow-line 200 cm. main-line tight, bow-line slack (Fig. 5).

Weights .

Kite A Kite B Kite C Kite Structure 9036 gms 8576 gms 8766 gms Main-line 5121 gms 5121 gms 5121 gms Bow-line 507 gms 507 gms 507 gms Total 14,664 gms 14,204 14,394 gms 6

3 Surfaces

Kite A 22.0 square meters oblique.

Kite B 13.7 square meters oblique.

Kite C 18.4 square meters oblique.

Flying-Weights . (Including the weights of the flying-lines, and considering all of the surfaces as efficient).

Kite A 667 gms. per sq m oblique.

Kite B 1037 gms. per sq m oblique.

Kite C 782 gms. per sq m oblique.

EXPERIMENTS MADE 1908 JULY 11 .

Experiment 1 :— Kite A was raised into the air by main-line attached 75 cm from zero point of keel s - stick. Three observations of wind velocity were then made.

623 ft in 30 sec or 14.2 miles per hr.

572 ft in 30 sec or 13.0 miles per hr.

544 ft in 30 sec or 12.4 miles per hr.

After this the altitude of the kite in the air and the pull of the flying-line were observed simultaneously and ten successive readings were obtained

Obs. Altitude Pull 1st 28° 45 lbs. 2nd 27° 40 lbs. 3rd 27° 35 lbs. 4th 30° 45 lbs. 5th 29° 55 lbs. 6th 28° 50 lbs. 7th 27° 45 lbs. 8th 27° 35 lbs. 9th 29° 45 lbs. 10th 32° 50 lbs. Summation 10 Obs. 284° 445 lbs. Average 1 28°.4 44.5 lbs. 7

4 After the conclusion of these observations another reading of wind-velocity was taken.

651 ft in 30 sec., or 14.8 miles per hr.

Field Notes :— Wind puffy. Kite steady when wind was steady. Some swaying during lulls or variations of force, but no regular oscillations. Kite could support itself on bow-line.

Brought down safely into the hands of the men without touching the ground. Wind seemed about SSW but exact direction uncertain as it was partly reflected from side of mountain as well as blowing directly on testing-field. Fluctuations perhaps caused or helped by interferences between direct and indirect impulses.

Experiment 2 :—Kite B flown by main-line attached 75 cm from zero point.

Initial wind-velocity 519 ft in 30 sec or 11.8 miles per hr.

Obs. Altitude Pull. 1st 27° 60 lbs. 2nd 20° 30 lbs. 3rd 25° 60 lbs. 4th 24° 35 lbs. 5th 24° 30 lbs. 6th 23° 50 lbs. 7th 25° 40 lbs. 8th 27° 65 lbs. 9th 26° 50 lbs. 10th 24° 30 lbs. Summation 10 obs. 245° 450 lbs. Average 1 24°.5 45.0 lbs.

Final wind-velocity 688 ft in 30 sec or 15.6 miles per hr.

Field Notes :—Kite B acted much as Kite A did, being steady in steady wind, and moving about in unsteady, but not showing any tendency to regular oscillation. Would not support itself on bow-line, and is evidently a heavier-flying Kite than Kite A.

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5 Experiment 3 : Kite C flown by main-line attached 75 cm from zero point.

Initial Wind Velocity 541 ft in 30 sec or 12.3 miles per hr.

Obs. Altitude Pull. 1st 24° 60 lbs. 2nd 29° 45 lbs. 3rd 30° 60 lbs. 4th 31° 60 lbs. 5th 29° 55 lbs. 6th 28° 50 lbs. 7th 30° 60 lbs. 8th 34° 70 lbs. 9th 31° 60 lbs. 10th 30° 55 lbs. Summation 10 obs. 296° 575 lbs. Average 1 29°.6 57.5 lbs.

Final Wind Velocity 613 ft in 30 sec or 13.9 miles per hr.

Field Notes :— Not much difference between kites A, B and C so far as steadiness goes in steady winds, but Kite C seemed to respond more quickly to changes of wind velocity than the others. No regular oscillation. Swaying motions greater than A or B, but wind variations were also greater. Before taking observations of altitude and pull the wind lulled, followed by a considerable puff, and kite C made a complete somersault in the air, regaining its equilibrium again and flying well so that we were able to complete our set of observations.

Experiment 4 :— Kites A and C were next flown simultaneously, upon similar lines sufficiently far apart to prevent the kites from coming together in the air. In this way it was hoped to test their relative behavior under identical wind-conditions No observations of altitude or wind velocity were made; but, while observations upon steadiness were being made the Laboratory assistants utilized their time by taking several series of observations of pull in the following order:—

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6 First ten observations of C, and 10 of A; then 10 of A, and 10 of C; and finally 10 of C and 10 of A. The results are shown below:—

Pull in Pounds.

Obs.	1st C	2nd A	3rd A	4th C	5th C	6th A
1st	50	50	60	70	50	35
2nd	45	45	50	60	40	40
3rd	40	55	40	65	30	30
4th	50	65	45	55	30	20
5th	55	90	55	45	35	15
6th	45	60	50	40	30	20
7th	40	50	70	45	35	25
8th	20	55	45	50	25	50
9th	20	50	55	40	20	45
10th	40	45	50	30	25	55
Sum. 10 Obs.	405	565	520	500	320	335
Av. 1	40.5	56.5	52.0	50.0	32.0	33.5

Field Notes :—Hardly any question that A is a steadier Kite than C although both flew well. C seemed to respond quickly to fluctuations of wind by movements in the air; while A appeared to be more sluggish, acting somewhat like a water-logged vessel which does not lift readily to the waves. Occasionally one Kite would be rising in the air while the other was falling, or one would give evidence of being struck by a squall which the other did not feel, thus showing that the Kites were by no means under indentical wind conditions, although both were in the air at the same time and only a short distance apart.

Kite C was then taken down; and Kite B raised in its place. Kite A was left flying continuously for comparison.

10

7 Experiment 5 :— Kites A and B flown simultaneously. The following observations of pull were made while the comparative behavior of the Kites in the air was being studied:—

Pull in Pounds.

Obs.	1st A	2nd B	3rd B	4th A	5th A	6th B
1st	45	50	60	50	35	40
2nd	50	40	50	45	30	45
3rd	60	35	40	40	25	60
4th	60	45	50	35	25	55
5th	50	30	55	40	25	40
6th	40	30	50	30	20	45
7th	45	25	45	30	20	50
8th	50	20	50	25	25	40
9th	10	15	55	20	45	35
10th	45	30	45	20	25	35
Sum. 10 Obs.	510	320	500	335	275	445
Av. 1	51.0	32.0	50.0	33.5	27.5	44.5

Field Notes: — No decided difference of behavior observed between Kites A and B in the air, excepting that Kite B flew at a lower altitude than A, and has every indication of being heavier-flying kite than A, requiring more wind to sustain it. After the ninth observation in the sixth series (when a pull of 35 lbs. was obtained) Kite B came down of itself, leaving Kite A still flying. It was raised again and the tenth reading of pull was obtained (35 lbs.) after which Kite B came down again, Kite A remaining in the air. After Kite B had fallen for the seond time a reading of wind-velocity showed 663 ft in 30 sec or 15.1 miles per hr., but it seems hardly possible that the wind was blowing at this rate when the Kite began to fall. So far as steadiness was concerned there was little to choose between Kites A and B. The impression has been created that Kite B is more sensitive to gusts than A, but if there is really any difference between them in this respect it is slight, and not nearly so noticeable as in the case of Kite C.

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8 Experiment 6: — Kites A and B were then taken down, and an unsuccessful attempt was made to fly the Old Frost-King Kite in its present empty condition. The wind-velocity was first taken and found to be 512 ft in 30 sec or 11.6 miles per hr. Then three men ran with the flying-line and thus raised the Frost-King into the air. The wind was not sufficient to support it there, and after it came down another reading of wind-velocity was taken, 585 ft in 30 sec or 13.3 miles per hr. This ended the experiments for the day.

Summary of Observations July 11, 1908 .

Summarizing all observations of wind-velocity and pull made during the afternoon of July 11, we obtain the following results:—

Wind-Velocity.

No of 30 sec Obs. Aggregate wind in feet Average in feet Average Wind in miles per hr. 11 6511 591.9 13.5

Summary of Pulls.

Kite No of Obs Aggregate pull in lbs. Average pull in lbs. Kite A 70 2985 42.6 Kite B 40 1715 42.9 Kite C 40 1800 45.0

Thus, in an average wind of 13.5 miles per hour:—

Kite A pulled 42.6 lbs.

Kite B pulled 42.9 lbs.

Kite C pulled 45.0 lbs.

12

9 Summarizing all cases in which the angular altitude of the Kites in the air was observed we obtain the results shown in the following table, which also summarizes the pulls obtained simultaneously with each observation of altitude, and the wind-velocities observed immediately before, and immediately after each series of observations. The table shows the results of experiments 1, 2 and 3.

Summary of Results of Exps. 1, 2 &3, July 11, 1908 .

Attachment of flying-lines: Main line 75 cm; bow-line 200 cm.

Wind-velocity Altitude Pull Flown by main-line No of 30 sec Obs. Wind in feet No of Obs. Altitude in degrees No of Obs. Pull in lbs. Kite A 2 1195 10 284° 10 445 Kite B 2 1207 10 245° 10 450 Kite C 2 1154 10 296° 10 575

Averages derived from above table .

Kite Wind in miles per hr. Altitude in degrees pull in lbs. Kite A 13.6 28°.4 44.5 Kite B 13.7 24°.5 45.0 Kite C 13.1 29°.6 57.5 13

10 Taking Kite A as our basis of comparison we may note that Kite B, while having about the same pull in nearly the same wind, flew at a sensibly lower angle than Kite A.

Kite C, flying in a wind of slightly less velocity than Kite A flew at a greater altitude with a greater pull.

These results suggest that possibly Kite C is more efficient than Kite A; and Kite B less efficient.

The indications are however, derived from the above table of averages alone, and do not take into account the total load lifted, including the weights of the Kites, the weights of the flying-lines, and the resolved vertical element of the pull.

In steadiness of flight there was little observable difference between Kite A and B; but C was apparently not quite as steady in the air; and the somersault executed by Kite C during the course of experiment 3, should lead us to very sure of the results before accepting Kite C as a model for aerodrome Ho. 5 as we would naturally do if we judged by efficiency of lift alone.

The experiments should evidently be multiplied before reaching final conclusions.

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EXPERIMENTS WITH KITE A JULY 16, 1908: By A. G. Bell.

On Thursday, July 16, 1908, an attempt was made to obtain simultaneous observations of wind-velocity, altitude and pull. It was found practicable to take three or four observations of altitude and pull during the time taken to observe and record a single observation of wind-velocity. At a given signal the anemometer was started by an assistant and after

30 seconds was stopped. When the anemometer was started Mr. Bedwin directed the clinometer at the kite while a third assistant kept his eyes fixed upon the fluctuating needle of the dynamometer. As Mr. Bedwin caught the angle he called to his assistant who noted the reading of the dynamometer at that moment. Then the readings of the three instruments were recorded, and another set of similar observations taken.

The following are the results obtained with Kite A flown with the main-line attached to the keel-stick at 50 cm from the zero point.

15

2 Kite A July 16, 1908

Wind Velocity Altitude Pull No of Obs. ft. in 30 sec. No of Obs. Altitude in degrees No of Obs. Pull in lbs. 1 524 1 30° 1 30 1 39° 1 40 1 34° 1 50 1 501 1 34° 1 40 1 36° 1 40 1 36° 1 40 1 423 1 35° 1 50 1 34° 1 40 1 36° 1 30 1 31° 1 20 3 1448 10 345° 10 380

Averages .

Wind-velocity 482.7 ft in 30 sec or 11.0 miles per hr Altitude 34°.5

Pull 38.0 lbs.

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EXPERIMENTS WITH KITES A & B JULY 17, 1908: by A. G. Bell.

On Friday July 17, 1908, eight series of observations were made with Kites A & B. Both kites were in the air at the same time and the observations were made upon them successively as shown below: Kite A was tethered to the lower cleat in the testing field, Kite B to the upper. In all cases the main-line was attached to the keel-stick at 50 cm from the zeropoint and the kites were flown by the main-line, the bow-line being slack.

Exp. 1. Kite A (at lower cleat)

Wind Velocity Altitude Pull No of Obs. Ft. in 30 sec. No of Obs. Altitude in degrees No of Obs. Pull in lbs. 1 562 1 42° 1 55 1 40° 1 55 1 39° 1 50 1 523 1 38° 1 55 1 31° 1 45 1 37° 1 40 1 34° 1 40 1 558 1 34° 1 35 1 36° 1 40 1 39° 1 50 3 1643 10 370° 10 465 17

Exp. 2. Kite B (at upper cleat).

Wind Velocity Altitude Pull No of Obs. Ft. in 30 sec. No of Obs. Altitude in degrees No of Obs. Pull in lbs. 1 536 1 35° 1 40 1 32° 1 40 1 30° 1 35 1 29° 1 45 1 624 1 33° 1 45 1 33° 1 40 1 35° 1 45 1 621 1 28° 1 35 1 26° 1 35 1 21° 1 35 3 1781 10 302° 10 395

Exp. 3. Kite A (at lower cleat)

Wind Velocity Altitude Pull No of Obs. Ft. in 30 sec. No of Obs. Altitude in degrees No of Obs. Pull in lbs. 1 556 1 41° 1 50 1 40° 1 50 1 39° 1 40 1 38° 1 45 1 512 1 37° 1 40 1 36° 1 40 1 37° 1 45 1 530 1 39° 1 30 1 40° 1 35 1 40° 1 50 3 1598 10 387° 10 425 18

Exp. 4. Kite B (at upper cleat).

Wind Velocity Altitude Pull No of Obs. ft. in 30 sec. No of Obs. Altitude in degrees No. of Obs. Pull in lbs. 1 573 1 29° 1 40 1 22° 1 30 1 26° 1 45 1 29° 1 50 1 543 1 29° 1 35 1 28° 1 40 1 28° 1 35 1 639 1 32° 1 45 1 33° 1 50 1 33° 1 50 3 1755 10 289° 10 420

The kites were now taken down and reversed in position that is Kite A was taken to the upper cleat and fastened to the flying-lines used with Kite B in the former experiments (2 and 4); and Kite B was taken to the lower cleat and attached to A's lines. Both kites were then allowed to fly from their new position and four other series of observations were made.

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Exp. 5. Kite A (at upper cleat)

Wind Velocity Altitude Pull No of Obs. ft. in 30 sec. No of Obs. Altitude in degrees No of Obs. Pull in lbs. 1 600 1 41° 1 40 1 40° 1 45 1 39° 1 45 1 42° 1 65 1 654 1 40° 1 40 1 39° 1 45 1 35° 1 50 1 635 1 37° 1 35 1 36° 1 40 1 37° 1 35 3 1889 10 386° 10 450

Exp. 6. Kite B (at Lower cleat)

Wind Velocity Altitude Pull No of Obs. ft. in 30 sec. No of Obs. Altitude in degrees No of Obs. Pull in lbs. 1 538 1 33° 1 55 1 27° 1 40 1 28° 1 45 1 31° 1 50 1 505 1 29° 1 40 1 29° 1 40 1 23° 1 30 1 479 1 28° 1 45 1 28° 1 40 1 32° 1 50 3 1522 10 288° 10 435 20

After this series of observations Kite B came down by itself while A continued flying. Kite B was left upon the ground while a new series of observations was made with Kite A.

Exp. 7 Kite A (at upper cleat).

Wind Velocity Altitude Pull No of Obs. ft. in 30 sec No of Obs. Altitude in degrees No of Obs Pull in lbs. 1 556 1 34° 1 40 1 33° 1 40 1 31° 1 35 1 32° 1 30 1 529 1 27° 1 35 1 36° 1 45 1 37° 1 45 1 487 1 33° 1 35 1 28° 1 25 Kite came down 3 1572 9 291° 9 330

An attempt was made to raise Kite A into the air so as to complete the series of observations but the kite would not support itself. An anemometer reading was taken and wind-velocity was found to be 411 ft in 30 seconds or 9.3 miles per hour. The wind seemed to freshen a little so an attempt was made to raise Kite B for a final series of readings. Wind-velocity 512 ft in 30 seconds or 11.6 miles per hr. Kite B remained in the air for a short time but came down before the readings could be made. Another attempt with wind at 372 ft 21 in 30 seconds or 8.5 miles per hr was even less successful. Kite B would not support itself. A third attempt with velocity 469 in 30 seconds or 10.7 miles per hr succeeded. Kite B rose into the air and remained there for a sufficient length of time to enable us to complete the series.

Exp. 8 Kite B (at lower cleat).

Wind Velocity Altitude Pull No of Obs ft. in 30 sec. No of Obs Altitude in degrees No of Obs Pull in lbs. 1 448 1 23° 1 40 1 25° 1 40 1 511 1 26° 1 45 1 30° 1 45 1 26° 1 40 1 28° 1 45 1 478 1 27° 1 45 1 20° 1 30 1 15° 1 30 1 23° 1 50 3 1437 10 243° 10 410

Kite B came down after conclusion of experiment. A final reading of the anemometer was then taken. Wind-velocity 468 ft or 10.6 miles per hr. This concluded the experiments for the day.

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Summary of results with kite A, July 17, 1908.

Wind Velocity Altitude Pull Reference No of Obs. Aggregate feet No of Obs. Aggregate degrees No of Obs. Aggregate lbs. Exp.1 3 1643 10 370° 10 465 Exp.3 3 1598 10 387°

10 425 Exp.5 3 1889 10 386° 10 450 Exp.7 3 1572 9 291° 9 330 Summation 12 6702 39 1434° 39 1670 Average 558.50 36.8° 42.8

Summary of results with Kite B,July 17, 1908.

Wind Velocity Altitude Pull Reference No of Obs. Aggregate feet No of Obs. Aggregate degrees No of Obs. Aggregate lbs. Exp.2 3 1781 10 302° 10 395 Exp.4 3 1755 10 289° 10 420 Exp.6 3 1522 10 288° 10 435 Exp.8 3 1437 10 243° 10 410 Summation 12 6495 40 1122° 40 1660 Average 541.25 28°.1 41.5 23

Averages .

Derived from above Tables. Kites flown by mainline attached at 50 cm from zero.

Kite Wind Velocity in miles per hour Altitude in degrees Pull in lbs. Kite A 12.7 36°.8 42.8 Kite B 12.3 28°.1 41.5

Conclusions :— These results are confirmatory of those reached July 11 1908 when the kites were flown from a point 75 cm from the zero on the keel-stick. In the above experiments July 17, 1908 the attachment was 50 cm from the zero point.

In both cases Kite B while having nearly the same pull as Kite A in a wind of approximately the same velocity, flew at a lower elevation.

Kite A with its flying-lines weighed 14,664 gms, Kite B 14,204 gms so it appears that under the same conditions of experiment Kite A lifted a greater load than Kite B; and to a greater elevation.

It is obvious then that the silk surfaces which were present in Kite A and which were absent in Kite B were not entirely useless. However much they may have been shielded by the winged cells in front of them some of them certainly aided in the support of Kite A.

There can no longer be any question that the full tetrahedral construction as exemplified by Kite A is superior to the empty form of construction typified by Kite B in which the supposedly superfluous surfaces are removed, without 24 removing the frameworks upon which they were stretched.

No sufficient reason exists for adopting the B type of construction in Aerodrome No.5 in place of the full construction employed in the Cygnet , which is exemplified by Kite A.

It is hoped that an opportunity may soon present itself for making equally decisive tests of the relative merits of Kites A and C.

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EXPERIMENTS WITH KITES A & C, 1908, JULY 29: By A. G. Bell.

Experiments with Kites A & C were made on the Beinn Bhreagh Testing-field, Wednesday, July 29, 1908.

Kite C was first raised by running in a wind of 10.5 miles per hour. It stayed up for a short time but came down before instrumental readings could be obtained.

After waiting some time Kite C was raised again and this time it remained in the air. We then let the anemometer run for 68 seconds while simultaneous observations of altitude and pull were made. Anemometer registered 1048 ft of wind in 68 seconds. We have therefore noted wind-velocity as 10.48 miles per hour following Baldwin's rule in Bulletin III p.45.

The photograph appended shows the Beinn Bhreagh experimenters taking simultaneous observations of the anemometer, clinometer, and dynamometer; and also incidentally shows one of the kites in the air.

In all the experiments 1908, July 29, the attachment of main-line was at point plus 50, bow-line plus 200, main-line tight; bow-line slack.

The following tables show the results of the experiments:

43. Taken 1908 July 17 th , 1909 July 20

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Exp.1 Kite C flown by main-line attached at + 50. Wind 10.48 miles per hr.

Obs. Altitude Pull. 1st 29° 50 lbs. 2nd 29° 50 lbs. 3rd 28° 30 lbs. 4th 31° 60 lbs. 5th 25° 30 lbs. 6th 32° 70 lbs. 7th 33° 50 lbs. 8th 32° 40 lbs. 9th 33° 60 lbs. 10th 29° 40 lbs. 10 cbs. 301° 480 lbs.

Exp.2 Kite C flown by main-line attached at + 50. Wind 11.85 miles per hr.

Obs. Altitude Pull 1st 25° 40 lbs. 2nd 26° 30 lbs. 3rd 28° 60 lbs. 4th 33° 50 lbs. 5th 32° 40 lbs. 6th 28° 40 lbs. 7th 34° 40 lbs. 8th 33° 50 lbs. 9th 33° 40 lbs. 10th 34° 40 lbs. 10 Obs 306° 430 lbs.

Kite C was now taken down and Kite A was raised by running with main-line. It was with difficulty that kite A was kept in the air by careful nursing. The only observation made was win? 11.10 miles per hr.

After a while Kite supported itself for a short time Altitude 18°, pull 20 lbs; wind 11.08 miles. Wind then freshened to 14.09 miles but lulled again before observations of altitude and pull could be taken. For several minutes the kite was almost supported but not quite. It was kept up however by nursing until observations could be made.

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3 Exp.3 Kite A flown by main-line attached at + 50 cm. Wind 11.79 miles per hr.

Obs. Altitude Pull 1st 30° 70 lbs. 2nd 31° 70 lbs. 3rd 35° 80 lbs. 4th 30° 40 lbs. 5th 36° 70 lbs. 6th 38° 80 lbs. 7th 35° 70 lbs. 8th 29° 20 lbs. 9th 33° 70 lbs. 10th 32° 40 lbs. 10 Obs 329° 610 lbs.

Exp.4 Kite A flown by main-line attached at + 50 cm. Wind 14.76 miles per hr.

Obs. Altitude Pull 1st 34° 80 lbs. 2nd 30° 70 lbs. 3rd 32° 60 lbs. 4th 31° 40 lbs. 5th 33° 50 lbs. 6th 38° 70 lbs. 7th 36° 60 lbs. 8th 36° 70 lbs. 9th 33° 60 lbs. 10th 35° 70 lbs 10 Obs 338° 630 lbs.

Exp.5 Kite A flown by main-line attached at + 50 cm. Wind 12.51 miles per hr.

Obs. Altitude Pull. 1st 33° 50 lbs. 2nd 33° 70 lbs. 3rd 36° 70 lbs. 4th 32° 40 lbs. 5th 37° 70 lbs. 6th 36° 40 lbs. 7th 32° 50 lbs. 8th 35° 60 lbs. 9th 35° 60 lbs. 10th 36° 60 lbs. 10 Obs. 345° 570 lbs.

Kite A was then taken down and Kite C raised in its stead.

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4 Exp 6. Kite C flown by main-line attached at + 50 cm. Wind 13.94 miles per hr.

Obs. Altitude Pull 1st 37° 90 lbs. 2nd 36° 70 lbs. 3rd 38° 80 lbs. 4th 31° 50 lbs. 5th 26° 50 lbs. 6th 34° 90 lbs. 7th 36° 90 lbs. 8th 39° 100 lbs. 9th 37° 80 lbs. 10th 36° 70 lbs. 10 Obs. 350° 770 lbs.

Exp. 7. Kite C flown by main-line attached at + 50 cm. Wind 12.57 miles per hr.

Obs. Altitude Pull 1st 37° 60 lbs. 2nd 36° 70 lbs. 3rd 32° 45 lbs. 4th 34° 50 lbs. 5th 36° 60 lbs. 6th 36° 50 lbs. 7th 38° 60 lbs. 8th 38° 70 lbs. 9th 36° 60 lbs. 10th 38° 70 lbs. 10 Obs 361° 595 lbs.

Exp. 8. Kite C flown by main-line attached at + 50 cm. Wind 16.35 miles per hr.

Obs. Altitude. Pull. 1st 34° 80 lbs. 2nd 30° 50 lbs. 3rd 28° 60 lbs. 4th 31° 50 lbs. 5th 34° 70 lbs. 6th 33° 40 lbs. 7th 35° 60 lbs. 8th 36° 80 lbs. 9th 36° 80 lbs. 10th 25° 60 lbs. 10 Obs. 332° 630 lbs. 30

5 Exp. 9. Kite C flown by main-line attached at + 50 cm. Wind 14.3 miles per hr.

Obs. Altitude Pull 1st 23° 40 lbs. 2nd 30° 70 lbs. 3rd 34° 80 lbs. 4th 35° 60 lbs. 5th 37° 70 lbs. 6th 35° 70 lbs. 7th 38° 70 lbs. 8th 37° 60 lbs. 9th 36° 70 lbs. 10th 38° 60 lbs. 10 Obs. 343° 650 lbs.

Kite C then taken down and Kite A raised in its place.

Exp.10. Kite A flown main-line attached at + 50 cm. Wind 13.50 miles per hr.

Obs. Altitude Pull. 1st 35° 70 lbs. 2nd 33° 50 lbs. 3rd 36° 80 lbs. 4th 33° 80 lbs. 5th 35° 70 lbs. 6th 34° 60 lbs. 7th 27° 60 lbs. 8th 22° 60 lbs. 9th 23° 30 lbs. 10th 32° 70 lbs. 10 Obs. 310° 630 lbs.

Exp. 11. Kite A flown main-line attached at + 50 cm. Wind 11.98 miles per hr.

Obs. Altitude Pull. 1st 25° 40 lbs. 2nd 26° 50 lbs. 3rd 27° 60 lbs. 4th 30° 50 lbs. 5th 31° 40 lbs. 6th 29° 40 lbs. 7th 30° 60 lbs. 8th 22° 50 lbs. 8 Obs. 220° 390 lbs.

The Kite came down after the 8th observation. After waiting some time it was again raised by hand and sustained 31 6 itself for a short time. Wind 12.11 miles per hr; altitude 25°; pull 30 lbs. The Kite then came down again. Another attempt was made shortly afterwards wind 11.25 miles per hr, but Kite A would not support itself.

Kite C was then raised by hand. Wind 9.18 miles per hr. Kite C would not support itself. This ended the experiments for the day.

SUMMARY OF OBSERVATIONS JULY 29, 1908.

Kite A.

Wind Altitude & pull. Obs. Miles Obs. Alt. Pull Exp.3 1 11.79 10 329° 610 lbs. Exp.4 1 14.76 10 338° 630 lbs. Exp.5 1 12.51 10 345° 570 lbs. Exp.10 1 13.50 10 310° 630 lbs. Exp.11 1 11.98 8 220° 390 lbs. 5 64.54 48 1542° 2830 lbs.

Kite C

Wind Altitude & Pull. Obs. Miles Obs. Alt. Pull Exp.1 1 10.48 10 301° 480 lbs. Exp.2 1 11.84 10 306° 430 lbs. Exp.6 1 13.94 10 350° 770 lbs. Exp.7 1 12.57 10 361° 595 lbs. Exp.8 1 16.35 10 332° 630 lbs. Exp.9 1 14.13 10 343° 650 lbs. 6 79.31 60 1993° 3555 lbs.

Averages.

Wind Altitude Pull. Kite A 12.91 miles 32°.12 59.00 lbs. Kite C 13.32 miles 33°.22 59.25 lbs.

General Conclusion :—There seems to be no substantial difference between kites A & C. What little difference there is seems to be in favor of Kite C, but the wind-velocity was slightly greater.

7 11 observations of wind-velocity, made simultaneously with the observations of altitude and pull, yield a total of 143.85 miles of wind. The average velocity during the experiments, 1908 July 29, was therefore 13.1 miles per hour.

Summarizing all the observations made upon Kite A, 1908, July 16, 17, and 29, in which the Kite was flown by the main-line attached at + 50 cm we obtain the following results:—

Kite A. (Summary of Observations 1908, july 16, 17 & 29).

Wind Altitude & pull Obs. Miles Obs. Alt. Pull July 16 3 32.89 10 345° 380 lbs. July 17 12 152.26 39 1434° 1670 lbs. July 29 5 64.54 48 1542° 2830 lbs. Total 20 249.69 97 3321° 4880 lbs. Average 12.5 miles 34°.2 50.3 lbs.

All of the above data have been submitted to Mr. F. W. Baldwin. He will make calculations and report upon the efficiency of Kites A,B, & C in the above experiments. After the reception of his report we can judge better upon the bearing of the experiments upon the f ?? or m of structure to be adopted in the tetrahedral aerodrome A.E.A. No. 5.

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REPORT UPON THE EFFICIENCY OF KITES A B & C:— by F.W. Baldwin.

The measure of efficiency of a Kite is generally considered as the ratio between lift and drift. The lift is the sum of the forces acting in a vertical direction at the kite; and drift the sum of the forces acting in a horizontal direction at the kite.

If the drift be considered as the horizontal force (comparable to the thrust exerted by the propeller of a aerodrome) then the lift represents the weight sustained.

The most efficient aero-surfaces are those that support the greatest weight for a given drift; or, in other words those in which ratio lift divided by drift is greatest.

In our case the lift includes the weight of the kite, the weight of the flying-lines, and the vertical component of the pull; and the drift is the horizontal component of the pull.

The vertical and horizontal components of the pull are proportional respectively to the sine and cosine of the angle of altitude.

Interpreting the data relating to Kites A B & C in this way we arrive at the following conclusions concerning the relative efficiencies:—

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DATA SUPPLIED .

(Average wind-velocity, altitude & pull).

Wind Altitude Pull Kite 1908 Attachment of flying line Weight of Kite & lines in lbs. No of Obs Miles per hour No of Obs Angle in degrees No of Obs Pull in lbs. July 11 A 75 32.3 2 13.6 10 28°.4 10 44.5 B 75 31.3 2 13.7 10 24°.5 10 45.0 C 75 31.7 2 13.1 10 29°.6 10 57.5 July 16 A 50 32.3 3 11.0 10 34°.5 10 38.0 July 17 A 50 32.3 12 12.7 39 36°.8 39 42.8 B 50 31.3 12 12.3 40 28°.1 40 41.5 July 29 A 50 32.3 5 12.9 48 32°.1 48 59.0 C 50 31.7 6 13.2 60 33°.2 60 59.2 Summary A 50 32.3 20 12.5 97 34°.2 97 50.3

CALCULATED RESULTS .

Kite 1908 Lift in lbs. Drift in lbs. Efficiency July 11 A 53.46 39.14 1.37 B 49.95 40.95 1.22 C 60.10 50.00 1.20 July 16 A 53.82 31.32 1.72 July 17 A 57.95 34.29 1.69 B 50.80 36.62 1.39 July 29 A 63.65 49.98 1.27 C 64.15 49.58 1.29 Summary A 60.57 41.60 1.46 35

THE BEARING OF THE EXPERIMENTS WITH KITES A B & C UPON THE CONSTRUCTION OF AERODROME NO. 5: by F.W. Baldwin.

The general impressions made upon me by the experiments with Kites A B & C are as follows:—

As tests to determine whether or not the solid tetrahedral construction can be improved upon they seem to me conclusive. There is so little to choose between the flying abilities of Kites A B & C that I would say no reasonable doubt can still exist as to the inefficiency of a large number of cells when banked as in the Frost-King or Cygnet model (on a large scale).

Of course Kite B is an extreme case but I think Kite A is also extreme in the other direction and the happy mean lies somewhere between them (perhaps in the Kite C form).

Kite A has a flying weight of 411 gms per sq m (oblique). Kite B a flying weight of 626 gms per sq m (oblique) and has the disadvantage of uncovered cells in its in e terior. These uncovered cells surely offer a head resistance much greater than do the covered ones.

Now taking all this into consideration is there enough difference in the flying qualities of A & B to justify leaving cells in, where they are only an incumberance structurally, adding practically nothing to the strength of the machine, making it harder to build and inaccessible for repair and inspection after it has been built?

The results of comparison between Kite C and Kite A in which Kite C actually proved to be as light, if not a lighter flying kite than A, although of considerably heavier 36 2 flying weight still more strongly point to the existence of such marked blanketting in the solid form that we cannot shut our eyes to it.

There is one point which should not be lost sight of in making deductions from these experiments and that is, that what is true of these Kites on a small scale need not necessarily apply to larger Kites of similar design.

Because cells may be efficient in the interior of Kite A is no reason for assuming that similarly situated cells are efficient in a Kite the size of the Frost-King. The question of interference which is the one with which we are dealing depends directly upon the number of cells which deflect the wind, before it reaches the interior and rear cells, and not upon its position relative to some other kite of the same form but of different dimensions.

Let it be granted that Kite A is a better Kite than Kite B. What does it prove? Not that type A is any better than type B but simply that more than two rows of cells can be banked advantageously.

How many cells deep the shell should be is still a question which experiment alone can settle, but undoubtedly there is a limit. Last year the Frost-King had 705 cells cut out from its interior leaving a shell of 595 cells, that is 54% of its surface was removed yet in the only experiment made with it in this condition it flew in about the same wind and carried substantially the same load with a slightly higher 37 3 efficiency.

Now I do not claim that this particular form of shell is the best one but every experiment points very clearly to the fact that a large number of the cells in the interior of the big Kites are practically useless, or at least contribute so slightly to the lift of the machine as in no way to justify putting them in.

The onus of proof seems to me to fall heavily upon the solid form of construction. Unless good reason can be shown for putting them in why not leave them out?

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THE BEARING OF THE EXPERIMENTS WITH KITES A B & C UPON THE CONSTRUCTION OF AERDROME NO. 5 by A.G. Bell.

It is a little surprising to find so little difference in the efficiencies of Kites A B & C. Taking Kite A as our standard for comparison there can be no doubt, I think, that the efficiency of B is slightly less than that of A. This came out both in the experiments of July 11 and July 17 when the kites were directly compared (page 34).

In relation to Kites A & C the answer is not so conclusive. In the experiments July 11 the efficiency of C was slightly less than the efficiency of A; and in the experiments July 29 it was slightly greater (page 34).

I take it therefore that there is no substantial difference in efficiency between Kites A & C; and so slight a difference between Kites A & B that it is hardly worth considering. For the purposes of this inquiry we may consider that Kites A B & C are of substantially equal efficiency.

What bearing then have the experiments upon the type of structure to be adopted in aerodrome No. 5? The efficiencies being substantially the same, our choice of structure will depend upon other conditions than efficiency.

The type of structure employed in the Cygnet, typified by the A kite, was developed at Beinn Bhreagh as the result of numerous experiments which demonstrated that Kites composed of large aggregates of cells arranged in full construction were extremely steady in quite fluctuating winds.

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It developed that while the lifting power of winged cells was markedly inferior to the same surfaces arranged horizontally, a structure composed of multitudinous winged cells possessed the important quality of automatic stability, which was lacking in structures employing horizontal surfaces.

In comparing then different arrangements of winged cells efficiency is not the only desideratum involved, nor indeed the main d ? e sideratum at all. I have no doubt that from the point of view of efficiency horizontal surfaces are superior to oblique, but they are very unstable in the air.

Automatic stability is the great feature of the pure tetrahedral construction, so that I feel that this feature must not be sacrificed for any other consideration.

Mr. Baldwin and I seem to look at the matter from two different points of view which is a good thing for the development of true and just conclusions.

He desires to secure what would be technically be termed the most efficient structure: That is, the structure in which the ratio of lift to drift is greatest (pp.35–37).

While I am equally anxious to secure this point, I consider it only of secondary importance, stability, to my mind, being of the first consequence. I quite agree with all of Mr. Baldwin's conclusions provided that proposed modifications of the structure in the interests of efficiency, ease of construction, repair and inspection, etc., do not interfere with the demonstrated quality of stability possessed by the Cygnet construction (type A).

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While I am inclined to think that the type of structure shown in Kite C has many advantages over A, especially when used in a structure of large size, I must confess that I am not yet satisfied that it is as stable in the air as Kites of the A type.

While in experiments July 29 Kite C seemed to fly as steadily as Kite A, it should not be forgotten that in experiment 3, July 11, (page 8) Kite C executed a complete somersault in the air. Whether this indicates that its automatic stability is inferior to that of Kite A is a matter for serious consideration. This point, I think, should be developed experimentally before finally deciding to adopt it. If it can be shown that the C type of construction is equally stable with that of type A, it should, I think, be adopted in aerodrome No. 5, or some modifi e c ation of it involving the omission of the least efficient surfaces.

In conclusion I assume the position that the stability of the A type of Kite in large constructions having been abundantly demonstrated by experiment, we should not depart from it unless the other types of structure considered are demonstrably equal to it in stability. The onus of proof lies with the other forms of structure.

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BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

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Beinn Bhreagh, Near Baddeck, Nova Scotia .

TABLE OF CONTENTS .

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THE FUTURE OF THE A.E.A.

The members of the A.E.A. would do well to consider what is to be done with the Association after September 30, 1908 when the Association expires by limitation unless otherwise decided by vote of the members.

We have already completed three successful aerodromes, associated with the names of Selfridge, Baldwin and Curtiss. McCurdy's aerodrome No.4 will soon be ready for trial, and Bell's tetrahedral aerodrome No.5 will not be long behind. There may also be time for another tetrahedral aerodrome on the Oionos plan employing a tetrahedral framework and both oblique and horizontal surfaces. We certainly can do no more than this before September 30, and then what?

We cannot stop although the object of the Association at its inception has already been attained. The limit of our desire in the beginning was to "get into the air" by hook or by crook, and in any sort of a heavier-than-air machine in the nature of "an aerodrome propelled by its own motive power and carrying a man". We have made three successful aerodromes and more will doubtless follow, and four of us have already been in the air. Can we be satisfied with this, and cease our labors? We know we cannot; but we have already nearly reached the limit of our financial resources and we must consider ways and means and the best mode of procedure.

We now desire to push our aerodromes into commercial use and go on with improvements upon them. This means that we must find a company to take up the commercial end, and continue an Experiment Association to improve our apparatus.

2

The first step towards commercial use has been taken by instigating a patent investigation to find out whether we have accomplished anything patentable that could be sold to a company. The report of Mauro, Cameron, Lewis & Massie has not yet been received. The next step in the same direction should be the appointment of a Trustee for the Association to whom should be turned over any patents we may obtain, and all rights we may have of a commercial nature, such as rights to manufacture and sell our aerodromes, or exhibit them for money. Our Trustee should be a business man familiar with the organization of companies. He should be empowered to organize a company, or sell our rights, whatever they may be, to some company approved by him, and be instructed to turn over the proceeds to the Association, whether in cash, in fully paid up shares of the Company, or in any other form, to be divided up in accordance with our agreement of organization. This is all we can do at present to promote the commercial side of our investigation. Appoint our Trustee and let him attend to the commercial matters. Mr. Charles J. Bell would be an admirable man for Trustee, but it is very doubtful whether he would accept. He is also a very busy man and could not give much time to the affairs of the Association. Mr. Curtiss has closer affiliations with business men than any other member of the Association and perhaps he may be able to suggest the name of a suitable person to act as Trustee.

In continuing experiments to improve apparatus, it might be well to consider whether it might not be advisable to broaden out into an Association to promote experiments in 3 Aviation in America, increase our membership, and go to the public for donations and bequests in aid of experimental work. Your Chairman for one, would willingly donate to such an Association any proceeds that might accrue to him personally from our experiments in Aviation, and Mrs. Bell and others would probably contribute. A membership fee might also be charged sufficient to cover the cost of any printed publications.

Such an Association would have to be incorporated in legal form and it would probably involve the dissolution of the present Association to secure to the present members the proceeds of their researches without having to divide with new members. A new Association, on an enlarged basis, might promote the progress of Aviation generally in America (1) by interchange of thoughts between the members through periodically issued Bulletins: (2) by making grants of money to individuals to assist experiments in Aviation: (3) by examining and reporting upon plans relating to apparatus for Aviation, and in other ways.

Inventors as a rule are poor men and find difficulty in obtaining capital to put their inventions into operation. Capitalists, as a rule, are ignorant of what has been done in Aviation, and hesitate to embark in a new enterprize without some assurance of success. A favorable report from the Association, showing that proposed experiments are worthy of encouragement, would undoubtedly prove of value to inventors, and aid them in gaining the ear of Capitalists, thus helping the progress of Aviation in America.

4

Grants :— In making grants of money to individuals various stipulations might be made. The results of the experiments for example, should be communicated to the Association and published in its Bulletins. It might be agr r e ed that the money should be returned to the Treasury of the Association with interest should the researches prove remunerative, or perhaps an equival ? e nt in g f ully paid up shares of the exploiting Company.

These are simply a few thoughts for the consideration of the members. Another plan would be to continue the Association as at present organized for another limited period of time, arranging with Mrs. Bell for continued finanical ia ai d.

A. G. B.

5

FARMAN AND ST. LOUIS .

Another subject for serious consideration arises from Farman's visit to America.

It is a very tempting proposition to race the June Bug against Farman's machine for the honor and glory of America and the A.E.A., and incidentally to make some money for the Association. It is a very tempting proposition to exhibit the June Bug at St. Louis and receive the sum of ten thousand dollars. Such propositions, however, cannot be entertained by us.

Our Association has been organized for experimental purposes only, and we have unfinished experiments upon our hands that should occupy our attention quite up to the end of September.

Such exhibitions belong to the commercial stage of development not to the experimental, and might well be undertaken by a company organized to exploit our work, but not by us.

If we authorize public exhibitions of our aerodromes involving pecuniary transactions or emoluments, we at once lay ourselves open to attack from numerous inventors who will claim that we are infringing their patents, and we will be obliged to defend ourselves. The letter from Orville Wright in the present Bulletin indicates clearly what would happen and the Wright Brothers would not be the only aggressors.

We cannot control the expenses of litigation in which we appear as defendants, and we have no funds that could be used in our defense. As we are not a legally incorporated 6 2 Association each member would be liable for the debts and liabilities of the whole as in the case of an unlimited liability company and the wealthiest member of the Association would be compelled, against his will, to shoulder the expenses of litigation.

So long as we are an Experiment Association carrying on experiments, not for gain but simply to promote the art of Aviation in America, there can be no possible ground for legal action of any kind. But the moment we begin to make money look out for trouble. Litigation is certain to arise, and expensive litigation too. It would be rashness in the extreme for us to invite attack before we are ready for defence.

We should await the report of Mauro, Cameron, Lewis & Massie so that we may know what we may justly claim as our own, and we should proceed as soon as possible to organize a company, or sell out to a company, so as to provide ample capital for any purpose. Whether we are placed in the position of plaintiffs or defendants we must have capital behind us to see us through, and an organized company will be a necessity.

The work of manufacturing and selling aerodromes and of exhibiting them to the public for gain properly belongs to such a company; and it would be unwise for us to attempt any of these things without a legal incorporation and capital behind us.

7

WORK OF THE AERIAL EXPERIMENT ASSOCIATION AS RECORDED IN TELEGRAMS AND LETTERS FROM MEMBERS.

Telegrams .

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., July 26, 1908 :—Made four short flights, Curtiss one, Selfridge three; landed safely; everything O.K.

(Signed) J.A.D. McCurdy.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., July 27, 1908 :— Had grand afternoon and evening work-out with June Bug. Had many trials. Longest flight brought machine and McCurdy to spot where Curtiss landed July 4th. Time one minute and forty-five seconds. Machine absolutely intact. Curtiss has gone to Washington. Tom leaves to-morrow night.

(Signed) J.A.D. McCurdy.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., July 28, 1908 :—Tom in New York, Curtiss Washington. Made eight flights to-day, three of which took one minute and fifty seconds. Made turn but within six hundred yards of starting point. Flight about sixty feet above the ground. Machine intact.

(Signed) J.A.D. McCurdy.

Letters .

(Extract from letter to Mr. Bedwin).

Hammondsport, N.Y., July 11, 1908 :— We have made a lot of changes in the machine; have shifted my position forward until I am 4 ½ feet further forward than on the Red Wing. The same old engine is still doing the pushing. We are getting up one with mechanical valves for B.B.

(Signed) G. H. Curtiss.

8

(Extract from Letter to Mr. Bedwin).

Hammondsport, N.Y. July 20, 1908 :— Everything O.K. on here. Are getting out material for new machine. Am making a few changes over June Bug. Giving greater lateral extension and larger tips. Having the body all covered in to reduce head resistance. Two propellers and stronger running gear.

(Signed) J.A.D. McCurdy.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 4, 1908 :—Assembling machine; delayed for cloth. Send samples as soon as arrive.

(Signed) J.A.D. McCurdy.

9

(Extract from letter to Dr. Bell).

The Engineer's Club, New York, July 30, 1908 :—I have just run down to New York for a few days (till Saturday evening) to see Farman fly. Besides being an interesting sight, we thought that we might glean a few ideas from him and his machine to incorporate in our new aerodrome.

As I telegraphed you from Hammondsport Selfridge left there a few days ago for New York and incidentally to pay a visit to Dr. Woods, who is spending his holidays on Long Island. I have not seen him yet as I only arrived the morning Curtiss went to Washington to help Capt. Baldwin with the Government Balloon.

The day Selfridge left we had (Selfridge and I) a grand work-out with the June Bug. It was my turn to attempt a flight, so I started off with the incident of the White Wing still fresh in my mind. I think that watching Curtiss fly so often has instilled into our minds the motions to be gone through with in handling the machine from just talking things over, and I was surprised myself at the ease with which I could manipulate the controls.

I got so much confidence during the short flight which was down to the railway track across the potato patch that next time I tried a longer flight and succeeded in going the full length of the field, two thousand yards and over in the time of 1 minute and 45 seconds.***Selfridge thought that he would fly back but the machine refused to support him after 10 2 carrying him in the air for about 200 ft. He made two attempts after changing trousers with Mr. Bradford to reduce his weight, also changing shoes with me.

The machine, however, even with these precautions refused to fly so we thought that perhaps my reduced weight of 30 lbs. would make he difference. I also made the attempt but with the same result.

We then pushed the machine through the first three fields to the end of the oats and then I tried it again, and it carried me back across the potato patch to the track. Now what was the meaning of this? Selfridge thought that it was due to the porosity of the surfaces which seemed to be again porous; and I thought that perhaps it was due to bad? batteries. As Selfridge could not try again till the surfaces are revarnished he left Hammondsport that night, and I tried her again next day with new batteries. Well Sir, she flew beautifully, and carried me down to the limit of the field again; but as I made a few curves to test out the rudder, I was in the air for about 1 minute and 50 seconds. This time we pushed her back as before to the oats, and then I flew her home again.

The wind was by this time blowing just a little bit so we decided not to try again till the evening.

At six o'clock I tried her again and this time made a complete turn and got almost home about the middle of the potato patch when the power gave out and I dropped.

I tried several flights after that but each one was shorter than the preceding one owing to the power giving out in the engine.

11

I thought perhaps tha fault lay in the gasoline pipe which fed the carburetter. I had Ingraham put in large ones, and I decided to stay over another day and try that turn again. I made the complete turn three times that day but always on the first flight, in other words when the engine was perfectly cool each flight lasting the same length of time 1 minute and 50 seconds. I had to go high in order not to strike the down wing on the ground in making the turn.

I think that some day a great artist who has great powers of description will describe in writing the feelings and sensations of the aviator. Mr. Bell I had perfect control of the machine and could have steered her anywhere. Please don't consider this as a brag, I only put it that way to try and convince you that we have absolutely mastered the control of the machine. You can either steer her round quickly or slowly as you will. I think the secret of making a successful turn is to go high (that is comparatively speaking of course).

I made a series of flights yesterday and completed the turn every time, but each time as before the power died away, and it turns out that the air-cooling is not perfect and will only cool for about 1 minute and 30 seconds, and allow the engine to develop its full power.

I think that we must have a water-cooled engine, one that will maintain a given power for a long period of time. I would suggest one similar to Capt. Baldwin's new engine which gave us a steady pull of 240 lbs. with a theoretical speed of adavance of 50 miles an hour. I don't know whether I wrote this 12 4 before but it is an astonishing fact. That engine will run in the stand for perhaps half an hour and develop its full power. What do you think about it? You know that the Frenchmen have discarded their air-cooled engine for water-cooled.

Couldn't we place an order with Curtiss for one to be got out at once in time to use on the new aerodrome; and then when we go to Baddeck we could take it along for the tetrahedral aerodrome?

I am satisified that the air-cooled engine we are using will not sustain the machine in flight for over 2 minutes in a straight course. This seems to be borne out by the fact that each flight was shorter than the preceding one.

About the Farman-St. Louis proposition. We have not heard of the detailed arrangement yet, but we have been given to understand that we would secure $10,000.00 to cover expenses if we would go.

Don't you think that if such a proposition were definitely put to us we could accept, and make the public pay some of our expenses?

I think with a water-cooled engine we could give old Farman a good run for his money, and you would be pleased to.***

(Signed) J.A.D. McCurdy.

13

WORK OF THE HAMMONDSPORT LABORATORY SINCE THE FLIGHT OF THE JUNE BUG, JULY 4th, 1908: by G.H. Curtiss, Director of Experiments.

After the winning of the Scientific American Trophy July 4th, we felt that it would be safe to do a little experimenting as we had accomplished our purpose and an accident to the machine would not be so serious as it would during the preparations for the Cup. Therefore on July 5th while the Aero Club members and visitors were still here, and after our little excursion and dinner on the Lake, we went to the testing grounds and got the June Bug out for the purpose of trying to fly it in a circle. The start was made as usual and after going about half a mile in a straight line, the writer attempted the curve. To do this, I steered, to the right with the rudder and inclined the right wing tip down at the same time by the movement of the shoulders. I made rather an awkward turn, either tilting the machine too much or not enough but finally got around and was headed back toward the starting point. The course back would have led over the vineyard and to avoid this, I attempted to make another turn to the right to get round the vineyard, and return over the same course I came out. I had probably lost considerable momentum on the first turn and the final cut down the speed to such an extent that I could not keep the machine in the air and had to make a landing. This broke a strut in the right wing which was depressed and also broke the front wheel. These repairs were made on the 6th and 7th, and on the 8th with some other slight alterations, another trial was made with a view of completing the circle and returning 14 to the starting point. The start was late, however, and it was so dark that it was hard to see the fences. After passing over one fence, I decided to land and not attempt the circle. Mr. Cameron witnessed this flight and was very much pleased.

On July 10th, the attempt was again made, and I made a flight of a mile circling around a large tree in the meadow and again failing to make the second turn but landed without accident.

Immediately after receiving a message from Doctor Bell in regard to building a Number 4, we became busy on the plans and have all of the designs worked out, including improved rigs, sockets, turn-buckles etc. We made a steam chest for making laminated work such as propellers and ribs. We now have all of the ribs made up and are in a position to make them in about one fourth of the time occupied by the old methods. All of the sockets are also made and ready for the No.4 as well as the turn-buckles and engine section of the frame. The propellers are well under way and the rubber cloth is ordered from Mr. Baldwin.

The tent we had been using belonged to Mr. Baldwin and as he had sold it we found it necessary to make some other arrangements for the storage of the machine. I therefore designed and ordered made a tent 20 ft. by 50 ft. to open on the side so that the machine can be wheeled out. This tent has been completed and delivered to us. We have it erected and the aerodrome in it. Baldwin's tent has been taken down and is ready for shipment.

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A few days last week were entirely taken up in testing out the Government airship engine much to the satisfaction of Mr. Selfridge as with this four cylinder engine a pull of 240 pounds was secured with a propeller ten foot in diameter, 15 degree and revolving at a speed of 550 rpm. The Government engine is water-cooled, being in a covered frame where it is difficult to cool by air.

Complete drawings have been made of the June Bug and of the best propellers, also of a clutch which we thought might be needed later. Drawings have been made for Aerodrome No.4.

16

A DEVICE FOR RAISING AND DEPRESSING AN AERODROME OR AEROPLANE WHILE KEEPING THE MACHINE ON AN EVEN KEEL: by T. Selfridge.

(First suggested by me on July 20th, 1908).

The present device of moving the June Bug up and down is, as you know, to raise or lower the front rudder, which operation always throws the machine off an even keel and causes in it an oscillation from fore to aft, or a pitching which must be corrected by further motion of the control. The machine as it now is corresponds to the old diving submarine and dirigible balloon both of which have been or are being discarded for the even keel type. This plan for the aeroplane is the same as that used in these other two engines (i.e. the submarine and the dirigible) of using two horizontal controls one in front and the other in the rear instead of a single one in front used by the June Bug. The machine will then be pushed bodily up and down instead of being inclined up and down, and the thrust of the propeller will always remain horizontal, hence there will be a less diminution of horizontal velocity also the resistance to horizontal movement of the whole machine will not be increased as it is now by the tilting of the whole structure, but only by the increased resistance of the two controls. In other words the stationary or fixed tail of the June Bug would be replaced by one which would be controlled by the same or different lever as the front control and move in connection with the front one so as to always maintain the machine on an even keel. (see accompanying illustration).

17

Dotted lines — wires connecting controls

18

HISTORICAL NOTES, TURNBULL'S RESEARCHES: by Thomas Selfridge.

W. R. Turnbull published an article entitled “Researches on the Forms and Stability of Aeroplanes” in the p P hysical Review, Vol.XXIV, NO.3, March 1907, later brought out in pamphlet form.

In it he describes a very interesting set of wind tunnel experiments to determine the relative efficiency of various forms of aerodromes. The velocity of the wind was the same in all cases, namely 10 miles per hour. He finally concludes that an [???] shaped curve at 8 ½° will give much greater efficiency than single curves. His measure of efficiency is the ratio of drift to lift. This reaches a value of 5.48 in this particular curve.

He started to apply this discovery to the construction of a hydroplane but has so far been prevented from making any practical tests of value due to engine troubles.

(This paragraph should follow the account of the Wright Brothers on page 28 of Bulletin NO.II).

19

IDEAS ON AVIATION: by G. H. Curtiss.

(Note:— In this paper Mr. Curtiss gives an account of his first experience in the air on May 22, 1908, in aerodrome, No. 2, Bal - d win's “White Wing”).

Although I have given the subject of aviation much thought, it was not until the flight of the “White Wing” on May 22, that my ideas of how to operate a heavier-than-air flying machine were tangible enough to be of any service to another. The act of flying, even though but the short distance of a thousand feet, gives a person something to work from, and his ideas follow on a more practical course.

Describing the flight of the “White Wing” on May 22, I will say that it had been my opinion during the previous experiments that the nose of the machine was rather light, and that the center of weight should be shifted forward and as my weight was some 20 pounds less than Selfridge's or Baldwin's, we placed the batteries and cell well in the nose.

The engine was started in the usual manner and after it had speeded up well, I gave the signal to let go. The flyer was being held by the tail at the upper end of the back stretch of Harry Champlin's half mile track on Stony Brook Farm. Upon being released she darted forward and sped down the track at a speed of perhaps 25 miles per hour. After about 300 feet, I inclined the control expecting to feel her rise into the air, but she failed to do so, and as I was nearing the end of the stretch, I shut off the power and grasped the lever of the steering wheel, guiding the 20 2 machine around the curve until she came to a stand still. Upon investigation we found that the engine had not been given the usual dose of oil, and that it had been running a little dry, and not giving power enough to push the machine into the air.

She was then taken back to the starting point, and after being given the usual dose of oil the engine was again started. Upon being released, she started down the track faster than before, and raised with the front control in the normal position. She glided for a short distance gradually rising to a height of 12 ft., and then seemed inclined to settle to the ground. I pulled back on the steering wheel thereby raising the front controlling plane slightly when the machine immediately rose and would probably have gone on to an indefinite height had I not reversed the plane again and brought it down, but as is usual in any balancing act, the novice over does matters, and I came down too far. As soon as I realized this, I again raised the control slightly. I afterwards learned that she touched the ground on this dip. By this time I realized that this vertical control was a very delicate thing, and although I did my best to keep on a constant level, there was more or less pitching up and down through the entire distance.

In the meantime, I had steered slightly to the left in order to make sure of clearing a vineyard which had been worrying us and which was directly in front of the start. When I found myself clear of the vineyard, I again turned to the right and on a line parallel to the track. There seemed 21 3 to be no trouble in steering in this direction.

When the machine first raised, the right side began to tilt down which was easily corrected by the use of the adjustable tips which were operated by leaning to the high side and engaging a lever with the shoulders. This control seemed to work very well indeed. After the plane was restored to its normal position the machine did not vary again.

I don't know just why I landed but I found myself so close to the ground that a landing seemed inevitable and rather than take any chance on trying to get up again, I shut off the engine, raised the front control to the limit, grasped the tiller of the front steering wheel with my hand and steered straight ahead out into the ploughed field until the machine came to a stand still.

The machine was found to be in good order and nothing broken. A bolt in the rudder had jarred loose and might have interfered with the steering had I gone farther.

I now believe that the front horizontal controlling plane should be hinged well to the front of the plane and a little forward of the center of pressure so as to dampen the inclination to turn the plane too much.

Also believe the machine should be mounted on small strong wheels with a longer wheel base than we have used. The two rear wheels should be under the rear edge of the main surfaces and the one front wheel should be as far forward as possible and pivoted so that it can be steered. A spring on this wheel would be of advantage, but not absolutely necessary A longer body with a tail placed farther back would also be 22 4 of an advantage in keeping the machine on an even keel.

I also believe that the nose of the machine should be entirely open so that the aviator can see the ground and better gauge distances. There would be only a slight increase of head resistance at the worst, and I am inclined to think there might be less. At any rate, with the consent of the others, I would like to try leaving off the cloth covering in front of the plane.

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EXPERIENCES IN THE AIR: by J.A.D. McCurdy.

(An account of Mr. McCurdy's flight in the White Wing, May 23, 1908).

On Saturday, May 23rd, 1908, experiments were continued with the aerodrome White Wing at Hammondsport, New York.

It was decided by the members of the A.E.A. present on the field that I should operate the machine. A few changes were made from the previous flight.

The connecting rod running from the steering wheel to the control was placed higher up on the strut which is perpendicular to the surface of the control, thus giving the operator greater leverage, and hence a more steady motion in changing the angle of incidence of the control. It was found from previous trials that the pressure of the air on the control was apt to cause a greater change of angle of incidence than the operator wished and consequently the flight of the machine was not as steady as it might otherwise have been.

In the flights made by Mr. Curtiss and myself the batteries and spark-coil were placed well forward in the nose in front of our feet, instead of ebing just behind the seat as in the case of Baldwin and Selfridge. This change was made on account of the difference in weight, Curti i s s and I being about 20 lbs. lighter. This change brought the balance of the machine about right.

It was a comparatively calm day, the wind only coming in puffs, but it was through one of these puffs that the machine met its Waterloo. Curtiss s ? t arted the engine and as in previous trials, the aerodrome was held by half a 24 2 dozen men till the engine was turning over properly and developing its full power. Curtiss gave the signal to let go, and in an absolute calm the machine started. She left the ground after running about 100 to 150 feet, and so gently did she rise that I was unconscious of any lift. The control was slightly depressed so the machine didn't rise till it j h ad full supporting power from its own velocity.

The machine took a slight turn to the left and then curved round to the right. The wind blew about on her port quarter, and as she turned to the right a puff elevated the port wing, and depressed the st r a rboard wing so that it caught in the grass. I leaned to the high side (port) with the idea of adjusting the tips so that a righting couple would be produced. As I was sitting too far forward my back failed to engage the lever which operates the tips, and so no righting result was produced.

I would like to say that my leaning to the high side of the machine was the result of thought, and not done intuitively. All the other m p o tions for control, and steering to right or left, or changing your elevation are done instinctively. I think that, as has already been suggested, if the wires which operate the tips were controlled from the steering wheel instead of by the body we would have a more natural movement. Such a method of control would undoubtedly change the course of the machine, b y u t this is what happens in the case of a bicycle or motor-cycle to preserve its equilibrium, and would come as a natural movement to us all.

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3 As the starboard wing struck the ground the machine pivoted about that tip, and the nose swung round and dug into the ground. The front wheel might have saved the resulting shock had the machine been on an even keel, but the wheel striking sideways was instantly disabled.

I was deposited gently and without any jar whatever on the ground, and the machine turned a complete somersault leaving me free from the debris. The engine stayed securely in its bed, and was therefor uninjured. The distance covered was about 600 feet at an elevation of about ten to twenty feet, and lasted for eleven seconds.

Before the machine started Lieut. Selfridge and his dog were standing directly in the path the machine would take in its run along the race track, so that Selfridge could note the exact time the machine left the ground and also mark the spo r t for future reference. So swiftly did the machine gather speed in coming down the track that Selfridge had not time to get out of the way, and his presence of mind warned him to lie flat on the ground.

I from my seat in the machine saw the dog scurry off through the grass, but did not realize that I had flown directly over Selfridge . In fact none of the A.E.A. were aware of the fact till Selfridge communicated it to us later.

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WORK OF BEINN BHREAGH LABORATORY:— by Wm. F. Bedwin, Superintendent.

We have on hand 50 small floats, which are simply small rubber bags which can be blown up with the mouth to a size approximately 50 cm long, and 5 cm in diameter. Have made and ready 40 silk bags in which these floats can be blown up. We have also two large rubber floats with silk bags for them. These measure, when blown up, about 300 cm long and 25 cm diameter. One of these floats blown up in its casing weighs 930 gms. We are getting material ready to make a structure to study a method of attaching these floats to a large machine. Have also one rubber tube received from Hammondsport which is considerably larger than the two me tn nt ioned above, and a lot heavier.

Have received from Hammondsport the new Anemo-Clinometer made by William Ferguson of the Blue Hill Observatory. Received with instrument a lot of blank charts for records; also two letters from Mr. Ferguson to the A.E.A. There were no pens or ink received with the instrument, and I telegraphed Mr. Curtiss at Hammondsport to send them forward.

Work is progressing rapidly on the construction of the new catamaran structure which was launched on the 30th of July and christened by Miss Gertrude Grosvenor, “The Get-Away” (see accompanying photographs which were taken of the apparatus after launching with a large party on board. Since launching “The Get-Away”, the tilting-arms used on the Ugly Duckling have been put on (see accompanying photographs), and other work such as steering gear etc., is nearing completion.

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Have put telephone line from Association's Beinn Bhreagh Headquarters to Superintendent's Office in the Laboratory Annex. We are at work on a globular connection device for tetrahedral structures, a model of which was completed August 1, 1908. We have one of these connection devices made of wood with 12 sockets of aluminum piping; and another made of aluminum entire y l y (see accompanying photographs).

Have started on construction of a twenty-two-celled kite made of 50 cm triangles mentioned in previous report, converted into 50 cm cells. Kite will be eight cells on top, seven cells on bottom, and two cells deep (see accompanying photograph), and will have guy wires strengthening the center parts of cell-sticks to illustrate Baldwin's method of trussing shown in Bulletin III page 44. Have repaired an old Oionos kite and made experiments with it. Experiments have been made on the following dates:—

1908, July 24:— Experiments with small rubber floats arranged catamaran fashion.

1908, July 28:— Experiments with the B B towed by the Gauldrie to test the strain and the pull.

1908, July 29:— Experiments with Kites A & C. Full series of observations obtained.

1908, Aug. 1:— Old Oionos kite tried.

1908, Aug. 3:— Experiments with Oionos kite. Several series of observations were made to test efficiency.

Kite B has been taken to pieces and the material utilized in the construction of Kite D (see photograph) which carries out to the extreme the hollow plan of construction used in Kite C (Bulletin I, 36).

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DECK PLAN THE GET AWAY Aug 1 1908

SIDE VIEW THE GET AWAY AUG. 1. 1908

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36

WAS THE DESTRUCTION OF BLERIOT'S MONOPLANE AERODROME JULY 23, 1908, CAUSED BY THE GYROSCOPIC ACTION OF ITS PROPELLER? by A. G. Bell.

The New York Herald of Friday July 24, 1908 (page 9) describes the destruction of Bleriot's Monoplane Aerodrome. The following is quoted from the account.

***“Bleriot fetched the machine out into the open and had the propeller turning in a second. Within a hundred yards he was well up in the air, traveling fifty kilometers an hour, apparently steady as a train; then he tried to turn. A height of ten meters, which had been attained, fell to eight in making the curve, but all seemed well. Then came the shock. A sudden gust of wind across the field caught the tail of the apparatus and threw it skyward. The head naturally tipped to the ground Before the operator had time to stop the motor, or even think about anything save holding on. Bleriot found himself sitting amid a heap of wreckage.” etc. etc.

It is difficult to understand how a gust of wind could have lifted the tail as stated; but a vertical dive of this kind might have been caused by gyroscopic action.

Perhaps Lieut. Selfridge can tell us whether Bleriot used a single propeller, the direction of its rotation, the direction in which Bleriot steered (left or right) when making his turn; and whether the reported dive was consistent with the gyroscopic effects noted in Bulletin III, Page 39.

37

TORQUE: by Mr. J. Newton Williams.

(Note:— Remarks by Mr. Williams following the reading of Mr. McCurdy's paper, May 17, 1908, revised for the Bulletin).

A shaft rotated in bearings by a force applied at one point, and with a resistant force at another point, develops torque, and as applied to flying-machines, aeroplanes in particular, a shaft parallel to the longitudinal axis of the machine, and with a rotative force at one end, applied from the machine, and a resistant force at the other end, which is attached or connected to the frame or structure of the aeroplane, then, whether the structure is resting upon the ground or suspended in the air, the torque of the shaft will have no effect upon the balance or equilibrium of the structure, being resisted, or absorbed at both points by the structure itself.

If, however, when suspended in the air, the resistant force, or its source, is disconnected from the structure, as atmospheric resistance to rotation of propellers, then the re-action of the applied force tends to turn the structure in an opposite direction.

If this shaft is concentrie with the longitudinal axis and center of gravity of the structure, when suspended in the air, then the torque will exert its <u>greatest</u> force in disturbing the latteral equilibrium. If while remaining parallel, the shaft is placed at a distance from the center of gravity, then, while extering, or developing just the same torque, its effect upon the balance or equilibrium of the structure would be reduced in proportion to the length of leverage 38 2 against which it was being exerted, and through which it was being resisted, by gravity and inertia. The length of leverage being represented by the distance of the shaft from the center of gravity.

If two separate propeller shafts are placed upon an aeroplane, parallel to its longitudinal center, they are necessarily some distance from each other, and from the center of gravity, and if rotated in opposite directions, the torque of each neutralizes the effect of the other upon the equilibrium of the structure.

If, however, they are both rotated in the <u>same</u> direction, the <u>resultant</u> force of the torque would tend to turn the structure about its longitudinal center of gravity, as the torque of <u>each</u> tends to revolve the structure in a different orbit, and around its own center of rotation, and the leverage through which this force is resisted, leaves the resultant force of the torque somewhat neutralized or reduced, and in the present state of the art probably a neglegible quantity.

(Signed) J. Newton Williams.

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LETTER FROM ORVILLE WRIGHT:

Dayton, Ohio, July 20th . To Mr. G. H. Curtiss, Hammondsport, New York. Dear Mr. Curtiss:

I learn from the Scientific American that your “June Bug” has moveable surfaces at the tips of the wings, adjustable to different angles on the right and left sides for maintaining the lateral balance. In our letter to Lieut. Selfridge of January 18th, replying to his of the 15th, in which he asked for information on the construction of flyers, we referred him to several publications containing descriptions of the structural features of our machines, and to our U.S. Patent #821,393. We did not intend of course, to give permission to use the patented features of our machine for exhibitions, or in a commercial way.

This patent broadly covers the combination of sustaining surfaces to the right and left of the center of a flying machine adjustable to different angles, with vertical surfaces adjustable to correct inequalities in the horizontal resistances of the differently adjusted wings. Claim 14 of our patent #821,393, specifically covers the combination which we are informed you are using. We believe it will be very difficult to develop a successful machine without the use of some of the features covered in this patent.

The commerical part of our business is taking so much of our time that we have not been able to undertake public 40 exhibitions. If it is your desire to enter the exhibition business we would be glad to take up the matter of a licence to offer it under our patents for that purpose.

Please give to Capt. Baldwin my best wishes for his success in the coming Government tests.

Sincerely yours, (Signed) Orville Wright. (Note:— The full correspondence with Mr. Orville Wright upon the above subject should, I think, be made known to all the members of the A.E.A. for it is obvious that we may expect to be brought into a law-suit with the Wright Bros., if we make any public exhibitions of our apparatus for gain without an arrangement with them. I do not know exactly the circumstances that led to the adoption of the moveable wing tips as I was in Washington at the time; but if, as I have reason to believe, their adoption was due to a suggestion of mine that moveable wing tips should be used, contained in a letter to Mr. Baldwin, I may say, that this suggestion was made without any knowledge upon my part of anything the Wright Brothers may have done. They had kept the details of construction of their machine secret; and I was ignorant of anything contained in their patent. I have no copy of their patent here, and do not therefore know whether their claim covers our wing tips or not. The matter should be enquired into by Messrs. Mauro, Cameron, Lewis & Massie and reported upon by them. They are more competent than we are to determine this point. A.G.B.).

BULLETINS OF THE Aerial Experiment Association

Bulletin No. VI Issued MONDAY, AUG. 17, 1908

ASSOCIATION'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN NO.VI ISSUED MONDAY AUGUST 17, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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AERODROME NO. 1, SELFRIDGE'S RED WING: by F. W. Baldwin.

(A paper presented to the Aerial Experiment Association May 17, 1908, revised for this bulletin).

The first motor driven aeroplane built by the A.E.A., which was known as the Red Wing had double superposed surfaces and would come under the class generally known as the Chanute type. There were two distinctive features in this design. The first was in the general principle and arrangement of the truss which supported the two surfaces and the second in the shape of the surfaces themselves.

The frame of the usual double decker, is the simple Pratt Truss, with parallel upper and lower chords and panels of consequently constant depth. The vertical posts in this form of truss are held at two points only (at the top and bottom). (See page 2).

In the Red Wing Truss (page 2) the upper and lower chords were made converging toward their extremities, giving the panels greater height in the center where the bending moments are at a maximum, and gradually decreasing in height towards the outside panels where the bending moments approach zero. In this way the height of the truss was proportional to the bending moments; and, as the stresses due to bending are by far the greatest ones to be considered, the structural advantage in having the chords bowed is obvious at a glance.

Another equally, if not more important advantage, is in the lateral support afforded to the vertical posts of the 2

Simple Pratt Truss

Red Wing Truss

3 truss by attaching them to a bow-string wire extending from tip to tip of the upper and lower chords. This fixes the uprights against lateral deflection at four points instead of two and theoretically increases their efficiency about fourfold.

Th great advantage in this is that besides lending itself naturally to lighter construction, it permits the use of struts very narrow in cross-section, materially reducing the head resistance offered by the framework.

All the exposed members of the main planes, tail, and bow-control, which were substantially at right angles to the line of flight were made of fish-shaped cross-section giving a form of least resistance according to experiments made by Prof. Zahm and conforming fairly well to stream-line theory. A number of different sizes of spruce sticks were made for this purpose. They were of four to one, and three to one dimensions, the largest size being 4“ × 1“ and the smallest 1 ½“ × ½“ (see page 4).

The other feature of the Red Wing which distinguishes it from the usual type of double-deck machine lies in the shape of the supporting surfaces. These are very much like a birds wing in plan, (see page 5), tapering towards the tips and at the same time decreasing in curvature.

Experiments published by W. R. Turnbull suggested the advisability of using aero-surfaces concave below in the forward position and convex in the after position.

The double curvature of the surfaces was obtained by the use of curved ribs made up of four laminations of wood 4

Cross-Sections of Struts Scale - Full Size.

5

Rib at central Panel

Rib at 2nd Panel

Rib at outside Panel

6 each #“ thick. The two outside strips were of ash to give them the required stiffness and the inner ones of spruce. These strips were laid up on a form and after being carefully glued together, retained their shape admirably without any apparent warping.

The spread of the wings from tip to tip was 43 ft. 4 inches. The depth of the surfaces at the center was 6 feet 3 inches, and the distance apart 6 feet, 6 inches at the center, and 4 feet at the outside panel. This gave a surface of 385.5 sq. ft. of silk.

The seat for the operator was arranged just above the lower surface in the control panel. His body was shielded by a rectangular spindle-shaped nose which was covered with silk and came to a point seven feet in front of the main planes. This nose was made of four bamboo poles with internal bracing and supported the bow-control which was a flat surface 8 feet across and 2 feet deep. It was balanced about a point one third back from its front edge and pivoted at the point of the nose (7 feet in front of the main planes). Yoke-ropes connected the bow-control to a steering drum just in front of the operator on his left hand side, and was manipulated either by turning the drum itself or a small spoke attached to it.

Fore and aft stability was also sought by the use of a fixed small surface tail. It was 14 feet 10 inches across, and 3 feet deep giving a surface of 44.5 sq. ft. This surface was placed horizontally 10 feet back of the rear edge of the main planes and was attached by bamboo poles guyed with piano wire

7

Right and left steering was effected by a square rudder 4 feet × 4 feet which pivoted about a vertical axis above the tail and was controlled by steering ropes which led to a lever just in front of the operator on his right hand side.

While there were no fixed vertical planes in the Red Wing, the fish-shaped uprights of the main truss offered a vertical surface calculated as 19 sq. ft., and undoubtedly contributed to the stability of the machine.

As the experiments with this machine were to be conducted over the ice it was mounted on runners. Two main runners with a tread of 2 feet 6 inches were placed below the center panel and supported nearly the entire load of the machine. A light runner was fixed under the tail and subsequently taken off as the machine retained its balance on the front runner alone. Two light runners were also placed under the second panels from the center in case the machine should come down sidewise in landing.

The main planes were given an angle of incidence of 7 ½ degrees. The engine used was a 40 horse-power, eight cylinder Curtiss, air-cooled motor. The bare engine weighed 148 pounds, but with the oil-tank, batteries, shafting, coil, etc., it weighed about 185 pounds.

The propeller was made of steel, had two blades, a diameter of 6 feet 2 inches, and a pitch of about 4 feet. It weighed 15 pounds and was driven direct, the engine and shafting being mounted horizontally. The fundamental idea in the design of the Red Wing was to produce an aeroplane with head resistance reduced to a minimum and power enough to ensure its getting into the air.

147559-T

RED, WING

AERODROME NO. 2, BALDWIN'S WHITE WING, SHOWING HOW IT DIFFERS FROM NO.1: by F.W. Baldwin.

(A paper presented to the Aerial Experiment Association May 17, 1908, revised for this bulletin).

The second motor driven aeroplane which has just been completed is as nearly as possible a reproduction of the Red Wing in general design. It is built of heavier material throughout and with slightly larger surfaces. The improvements are nearly all in the details of its construction.

In this machine, it was deemed advisable to get some positive method of controlling the lateral stability. The tips at the extremities of the wings are hinged about their fore edges and by a system of steering gear the angles of incidence can be changed by the operator. By this arrangement if the machine inclines to one side the man by leaning to the high side operates a tiller which is connected by steering ropes and increases the angle of incidence of the tips at the lower side and decreases the angle of incidence of the tips on the high side. This gives a righting couple which should keep the machine on an even keel, the idea being that the man will instinctively lean to the high side.

The bow-control has been placed a foot farther in advance of the main plane, and is 9 feet across and 2.5 feet deep. This control is operated by a lever connected directly to the steering post, and not by yoke ropes as in the Red Wing.

Right and left steering is provided for by a triangular rudder which swings about a vertical axis behind the after 10 central strut of the tail. The steering ropes from this rudder lead to the steering wheel in front of the operator which works like the steering wheel of a motor car, turning to the right putting the rudder over to the right and turning to the left putting the rudder over to the left.

The tail is composed of two superposed surfaces giving about the same surface as in the Red Wing and is placed 10 feet (the same distance) behind the main plane. This was done to remedy the weakness shown by the faulty construction of the single surface tail first used on the Red Wing. The box which constitutes the tail is given a slight angle with the engine bed (1 in 27 or 2°20“). In this it differes from the Red Wing in which the tail was parallel with the engine bed. The justification for this, by no means important, departure is that theoretically, it would seem that the machine when perfectly balanced should have all its surfaces, including controls, at the h m most efficient angle. That is, the angle at which the ratio t of lift to drift is greatest.

In the new machine, all members of the truss outside of the center panel fit into sockets and are thus more easily repaired than in the old construction with its through members. The uprights are fitted with a set-screw in ths socket so that they may be lengthened out or shortened, thus doing away with the necessity for turn-buckles on the diagonal wires. (see accompanying drawing page 11).

The upper and lower chords of the White Wing are not true curves as was the case of the Red Wing, but the members are straight between each panel. Another change from the old
11

<u>Socket full size Front Elevation Plan</u>

12

Connection device for members of central panel Scale — Full size

13 design is in the joints of the center panel. Mr. Bedwin devised a scheme for bolting the uprights through the upper and lower chords which is very much neater, stronger and lighter than the old way of straps and knees (see accompanying illustration page 12).

A wooden propeller is used on this machine with the same engine as before. The diameter is 6 feet, the pitch is slightly greater than the diameter. The weight of this propeller is only about 8 pounds and it should prove more efficient in every way.

The new machine is 43 feet 6 inches from tip to tip; the planes are 6 feet 6 inches deep at the center, and 4 feet deep at the t o utside panel, which gives a total supporting surface of 408.5 sq. feet. The weight of the main planes with the engine bed is 133 lbs. as against 119 lbs. in the case of the Red Wing. The nose weighs 27 lbs., the tail including a light wheel weighs 30.5 lbs. The wheels and the spring frames which support them weigh 47 lbs. The engine, accessories and propeller weigh 192 lbs. So the toal weight taking the man at 175 lbs. will be about 606 lbs. This gives a flying weight of about 1 ½ lbs. to the sq. ft. compared to 1 ¼ in the Red Wing.

The cloth used throughout (except for the tail which is silk) is of a quality of nainsook which weighs 7o grms. per square meter. Altogether the new machine is a great improvement over the old one in the matter of construction. While its struts are larger, more of its members are enclosed and it should not offer much more head resistance than the Red Wing.

20810-B

WHITE WING

15

AERODROME NO.3, CURTISS'S JUNE BUG, SHOWING HOW IT DIFFERS FROM NO.2: by G. H. Curtiss.

(A letter to Dr. Bell).

Hammondsport, N.Y., July 13, 1908 :— The following is an enumeration of the differences between Aerodromes No. 2 & No. 3:—

In No. 3 the wing tips were so set that when not in use, they were at a neutral angle while these in No. 2 when not working as controls were parallel to the surfaces. The gearing of the wing tips was simplified by the new arrangement of wiring necessitated by the operator's seat being moved farther to the front.

The main weights are separated by a greater distance in No. 3 than in No. 2. The engine was set five inches farther back and the man two feet farther to the front. The front control was also moved farther out and the front edge of it now 10 feet 10 # inches in front of the front edge of the main planes thus making the machine 27 ½ feet long. Five square feet have been added to the area of the front control, its total spread being now 13 feet 10 inches as compared with 11 feet 8 inches of No. 2. The nose is now wedge shaped instead of pointed and has been left uncovered.

The running gear consists of three wheels as before, but the wheel base has been extended two feet. It has also been greatly strengthened by two large wooden members running fore and aft which are to be used as skids in case the wheels break down.

The wings have been made so that they can be easily removed from the engine bed section and their surfaces have 16 been varnished with a mixture of gasoline, yellow ochre, parafine and turpentine in order to make them air-tight. The yellow ochre was used for photographic purposes. The working surfaces of the machine have been reduced from 408 to 370 sq. feet. Switch and spark controls have been placed on the front steering wheel.

The lower plane has been greatly strengthened by eight guy wires fastening it to the hubs of the wheels and bottom of the skids.

The engine section has been made up of lighter material, the struts being only ¾ of an inch thick at their widest part and 2 ¼ inches long instead of one inch thick at their widest part and 4 inches long as was used in No. 2. Additional guy wires have been added to this section and it is now more rigid than before.

The propeller has been cut down from 6 feet 2 inches to 5 feet 11 inches, and is now turning up to about 1200 rpm. instead of 1050.

The tail has been made spar-shaped from side to side so as to conform to the general shape of the main surfaces. The vertical surfaces of the tail have been removed and the area of the vertical rudder increased from 27 inches square to 36 inches square.

It has also been decided to do away with the screw sockets for the vertical posts and to put turn-buckles on each socket. We are also to use balloon rubber silk for the surfaces. These last changes have not yet been made however. The distance between the center of gravity of the operator and the center of gravity of the engine is now 6 feet.

147552-T

June Bug

747322-T

June Bug

BULLETINS OF THE Aerial Experiment Association

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BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN NO. VII ISSUED MONDAY AUGUST 24, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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WORK OF THE AERIAL EXPERIMENT ASSOCIATION AS RECORDED IN TELEGRAMS AND LETTERS FROM MEMBERS.

Telegrams .

To Dr. A.G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 6, 1908 :— Bound Washington to rush silk. Farman contemplating using our tips. Can't I hurry patent lawyers in securing applications for your immediate inspection? Reply Hammodsport.

J.A.D. McCurdy.

To Dr. A.G. Bell, Baddeck, N.S.

Washington, D.C., Aug. 15, 1908 :— In air two hours to-night. Over 30 miles covered. Trials now finished. Government officials pleased.

G.H. Curtiss. (Note:— Above refers to official trials of Capt. Baldwin's Balloon with Capt. Baldwin, and G.H. Curtiss on board.A.G.B.).

To Dr. A.G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 17, 1908 :— Shall we christen aerodrome Number four Silver-Dart? Nearly assembled.

J.A.D. McCurdy.

2

EXTRACTS FROM LETTERS .

TO Mrs. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 5, 1908 :— Farman's attempts were very disappointing indeed. The first day he flew 140 yards at elevation of 3 feet; time 11 seconds, which gives a velocity of about 20 miles an hour. He made two such flights that day and then wheeled the machine back to the tent.

The next day there were about 3000 persons in attendance and as it was too windy he did not attempt to fly at all much to the disappointment of the 3000 persons. They were, however, given “wind cheques” and told to come again the next day. We thought that we had seen all worth seeing so Tom and I left New York Saturday evening for Hammondsport. We were anxious to get back here and do some flying. We have however, had the engine overhauled and will be all ready this evening. We have also revarnished the surfaces.

Mr. Curtiss says that the reason that the engine over-heated was because it did not have sufficient oil, it being really an oil-cooled engine, so we have attached an additional tank giving an abundant flow of oil through four different feed pipes. Prof. Wood of Johns Hopkins University who is visiting us suggested that we cool the engine by packing the cylinders in absorbent cotton saturated with water. The specific heat of water being so high it would consequently absorb a large quantity of heat. We tried this experiment to-day in the testing-room with a single cylinder motor with startling results. We ran the motor on the stand for seven minutes with 3 2 perfect cooling while under ordinary circumstances we can only run it for one minute and then it gets hot. We could prolong the cooling by allowing a small stream of water to play on the cotton but this would necessitate a water-tank and feed pipes. We are going to try the cotton-cooled scheme on the eight cylinder this afternoon, and if it keeps us up for seven minutes, it will be quite an advance. We have decided that we ought to have a water-cooled engine and Curtiss says we can get it out in three weeks, and perhaps in time to use on the new machine.

J.A.D. McCurdy.

To Mrs. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 10, 1908 :— The No. 4 machine is about ready to assemble; the cloth for the surfaces is finished. John will b e r ing it from New York. Selfridge has been ordered to Washington, and I suppose we have lost him for the rest of the summer.

G.H. Curtiss.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 10, 1908 :— The propellers, transmission, etc., for the No. 4 are ready, and we will make a thorough test of the double propellers this week. Everything else is also ready to assemble. While in Washington I had a long talk with Mr. Cameron and we expect his draughtsman here today to finish the details of the machine.

G.H. Curtiss.

4

3 To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 12, 1908 :— Got back from Washington O.K. bringing with me the silk, a sample of which I am enclosing in this letter. It does look thin but it is impervious to the air and is not as weak as it looks. We have had so far no trouble with our surface tearing and this is a lot stronger than anything we have used so far. As a matter of fact I thought this would be a little heavier but it looks pretty good as it is.

I called on the patent office and told Mr. Cameron that we wished the patents rushed right through and that Farman was thinking about using our tips. He has been recalled from his vacation on account of his mother's illness and has promised to prepare our applications at once. They sent their draughtsman, Mr. Williams, down here and he made sketches of all the working parts to help Mr. Cameron in drawing up and wording the claims. Mr. Williams left here to-night for Washington.

All the parts are made for the new aerodrome and it is probable that we will have her assembled the middle of next week.

Mr. Curtiss has decided to build an eight cylinder water-cooled engine which we will try out in the new machine and if it proves satisfactory we can take it to Baddeck for the tetrahedral aerodrome. You certainly ought to have an engine which will maintain its power for a considerable length of time and the pure air-cooled won't do that.

5

4 This engine has certainly worked out well and we have had no trouble with it whatever, but now that we have passed the “seconds” stage and the “minutes” we want something to go into the “hours”.

I suppose you know that the new conditions for the Scientific American Trophy have been decided upon. They are to fly 25 kilometers rounding the starting-point, which means one complete circle anyway. The date set for this trial is September 7th and the entries must be in September 1st.

Do you think we ought to enter? General Allen says that he will allow the new Government machines (Wrights and Herrings) to enter providing they are delivered in time. Herring has been allowed an extension of 30 days for delivery.

Baldwins' balloon is a beauty and they are all pleased with it.

The official flight will be to-morrow. They have already made 18 miles an hour.

J.A.D. McCurdy.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 13, 1908: — We have started assembling the machine to-day and in about 3 days I am sure it will look like a real aerodrome.

J.A.D. McCurdy.

To Mr. F.W. Baldwin, Baddeck, N.S.

Hammondsport, N.Y., Aug. 13, 1908: — Mr. Curtiss thinks that with a little more oil feed to the cylinders we can get power for a longer period of time and so we are having a force feed pump 6 5 put on the engine, and I do hope it will prove satisfactory. We have not been doing any flying this week on that account and the assembling of the new machine takes up a lot of time and we want to get it finished in time to try before going to Baddeck. If that new water-cooled engine is only finished in time we will have a fair chance of beating Farman's record of 20 minutes 12 seconds in the air. What do you think of the new cloth?***

I was just in Washington long enough to get an order signed by Capt. Baldwin for that silk and to see a flight. Was in New York a day but didn't see any persons there as they were all in Washington.

J.A.D. McCurdy.

7

WORK OF BEINN BHREAGH LABORATORY by Wm. F. Bedwin, Superintendent.

Beinn Bhreagh Laboratory, Aug. 19, 1908 :—We have received from Mr. Ferguson of the Blue Hill Observatory a bottle of special ink, and three Richard pens for the Clino-Anemometer, an instrument which is to be sent up in a kite for the purpose of obtaining a record of wind-velocity at the kite itself, and of recording automatically the inclination of the kite surfaces to the horizon while the kite is in the air.

Tetrahedral Aerodrome No. 5 .

The "Get-Away" (Bulletin V, 28–31) is very nearly ready for work. We tried towing her with the Gauldrie some days ago, and succeeded in getting a speed of 5.62 miles per hour with four men on the "Get-Away" at the time of towing.

We have nearly finished two models of the proposed tetrahedral aerodrome No. 5, and we are now at work putting on the beading.

We have received from the Goodrich Rubber Company, through Mr. Curtiss, 20 large rubber tubes to be used as floats for the tetrahedral aerodrome No. 5. We have made a catamaran of two of these floats inflated with silk bags ready to try experiments with. (See accompanying photograph).

Tetrahedral Aerodrome No. 6 .

The globular connection-device for tetrahedral structures having large cells shown in Bulletin V, 32 were turned out upon a lathe. We have succeeded in making a solid casting of this device in aluminum, and also in casting one with a hollow center which looks well. (See accompanying photographs). 8 We are making up a lot of these glob ? u lar aluminum connection-pieces, some turned up on a lathe, and others cast. Between the two methods we will have enough to make a structure very soon. It is proposed to use these globular connection-devices upon aerodrome No.6, a tetrahedral structure of the Oionos form, having both horizontal and oblique surfaces. The structure is to be supported on the water by a hydroplane boat and it is hoped will rise directly from the water instead of being placed on the “Get-Away” to get away.

We have made a new boat with out-riggers to which we are going to attach hydroplanes. The hydroplanes are about ready, and we are at present putting an engine-bed upon the boat. (See accompanying photographs).

Dates of Experiments .

August 4, 1908:— Experiments with Oionos kite. 152 observations; 10 of wind-velocity, 71 of altitude, 71 of pull.

August 5, 1908:— Hydroplane experiments with the twin-boat “Edbert”. (Photograph of this boat is appended).

August 6, 1908:— One experiment with the “Edbert”.

August 8, 1908:— Hydroplane experiments with the “Edbert”; four experiments.

August 10, 1908:—Hydroplane experiments with the “Edbert”; one experiment.

August 11, 1908:—Hydroplane experiments with the “Edbert”; three experiments.

August 13, 1908:—Hydroplane experiments with the “Edbert”; eight experiments.

9

August 14, 1908:— Experiments with the Pilot Kite, Kite A, Kite C, Kite D, the old Oionos Kite, the Empty Frost-King Kite, and the White Kite with Baldwin's trussing. 160 observations. Wind-velocity 16 observations, altitude 72 observations, pull 72 observations.

August 18, 1908:— The new hydroplane boat (without the hydroplanes, which are not quite completed) with out-rigger and wooden floats was towed full speed by the Gauldrie to-day. 46 observations of the pull on the towing line were made yielding an average of 15.2 lbs.

10

85. Dev 1908 Aug Sud. 1908 AUG 19

86. Dev. 1908 Aug 20 Sud. 1908 AUG 19

11

1908 AUG 20

12

68. Dev. 1908 Aug 6 Sud 1908 AUG 5

69. Taken 1908 Aug 5 th Sud Dev 1908 Aug 6 th Sud

13

78. Taken Aug

88. Taken 1908 Aug 20 th Sud Dev. 1908 Aug 20 Sud

14

M. DUFAUX' ENGINE AND ITS ADAPTIBILITY TO OUR WORK: By F. W. Baldwin.

The art of making light engines for aeronautical purposes may fairly be considered to be in its infancy.

No distinct type of motor for aeronautical work has so far been developed and this alone indicates that what we are using is a very slightly modified marine or automobile motor neither of which is particularly well suited for the purpose.

First of all our engines are upside down, the crankshaft of a marine motor must for convenience be kept low and the cylinders naturally arrange themselves above it. This has pretty well standardized marine and automobile engines, but the exact opposite of this arrangement is the most natural one for aerodrome motors. We want the thrust high and the center of gravity low, and in an aerodrome there is room for the cylinders below the crank-shaft. Unless the cylinders are disposed all round the shaft why shouldn't they be underneath and not on top as we have them now?

I saw a description of Dufaux' engine the other day in L'Aerophile (Apl. 14 p. 141–144) which made a great impression on me. The whole design is a new and original combination of old and well known principles. There isn't a single feature of the engine that in itself is novel, but the combination looks good.

It is a double-acting, four cycle engine with 20 cylinders. There is no crank-case and the crank-shaft is on top. The cylinders are disposed two on each piston-rod, and by the 15 2 double-acting arrangement each cylinder is always on a power stroke.

The cylinders are V shaped upwards ( ) just the opposite to our eight cylinder engine; and the lubrication is of course force feed from three pumps, cam-driven off the crankshaft.

The cooling would probably be difficult but seems to be amply provided for by a generous supply of water through good sized copper-jackets and is naturally assisted by all the parts on the interior of the cylinders being hollow, and as there is no crank-case they get a good current of continually fr as es h air which should be a great advantage.

I know Mr. Curtiss does not like cylinders with the heads at the bottom because it does away with the possibility of splash lubrication, but has not splash lubrication got to go anyway?

Taking it altogether I see no reason why M. Dufaux' engine is not perfectly practicable; and if it is, why is it not a decided improvement over anything we have at present, in advantageous disposition of weight, possibilities for lightness and easy accessibility of parts.

16

EXPERIMENTS WITH OIONOS KITE, 1908, AUG. 1, 3, & 4. by A. G. Bell.

1908, Aug. 1 :—An old Oionos Kite resurrected from among the old models was tried to-day. For photograph see Bulletin V, page 34. Wind-velocity 4.85 miles per hour. Raised Oionos by running with the line and it sustained itself in the air for a short time, but as it could only be kept up by nursing it was allowed to fall on a slack line. It fell very gently and was uninjured. Another reading of the anemometer was then taken giving wind-velocity of 4.68 miles per hour.

1908, Aug. 3 :—Four series of experiments were made to-day with the Oionos Kite flown by a cord 209 meters long, weighing 975 gms and attached at point + 25 cm. Weight of kite without line 2820 gms. This Oionos kite had 2.4123 sq m of silk arranged horizontally and 2.6521 sq m arranged obliquely making a total silk surface of 5.0644 sq m. The following table gives a summary of the obseravtions made with the averages obtained:—

Experiments with Oionos Kite Aug. 3, 1908 .

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 1 2 12.81 10 322° 10 124.0 Exp. 2 1 7.65 8 328° 8 129.5 Exp. 3 1 6.74 10 387° 10 127.5 Exp. 4 1 5.28 10 364° 10 109.5 Total 5 32.48 38 1401° 38 490.5 Aver. 6.50 miles 36°.9 12.9 lbs.

1908, Aug. 4: —Experiments were made to-day to test the effect of loading the Oionos Kite with a piece of lead weighing 45 gms placed (1) at the extreme end of the beak, 110 cm from 17 2 the center of the kite so as to be as far forward as possible, and (2) placed under the tail, at a point — 50 cm from the center of the kite.

Experiments with Oionos Kite August 4, 1908 .

(Line + 25, lead + 110).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 1 1 12.55 10 354° 10 94.5 Exp. 2 1 12.65 10 380° 10 85.0 Total 2 25.20 20 734° 20 179.5 Aver. 12.60 36°.7 9.0 lbs.

(Line + 25, lead - 50).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 3 1 13.91 10 430° 10 115.0 Exp. 4 1 11.78 10 434° 10 102.0 Total 2 25.69 20 864° 20 217.0 Aver. 12.85 43°.2 10.9 lbs.

Averages .

(Exp. 1, 2, 3 & 4).

Wind Altitude Pull Load at bow 12.6 miles 36°.7 9.0 lbs. Load at stern 12.8 miles 43°.2 10.9 lbs.

In experiments 1,2,3 & 4 the kite flew steadily but it was found difficult to land it on account of vertical and horizontal oscillations when near the ground. It would strike on one wing and smash a few sticks. In experiments 5 a dangling bow-line was attached at point + 110, the extreme end of the beak, to facilitate landing.

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3 <u>Experiments with Oionos Kite, August 4, 1908</u> .

(Line + 25, Lead + 110; dangling bow-line + 110 weighing 75 gms & 25 m long).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 5 1 11.15 10 384° 10 104 Aver. 11.15 miles 38°.4 10.4 lbs.

The kite was beautifully s y t eady in the air, but wobbled coming down until a man caught the end of the dangling bow-line, which was only 25 m long. This at once steadied the kite, and it came down without further oscillation, and was caught by the man in charge without touching the ground.

The dangling bow-line was then lengthened to 65 m to enable the kite to be caught by the bow-line while still at a considerable elevation in the air.

Experiments with Oionos Kite, August 4, 1908.

(Line + 25, lead - 50; dangling bow-line + 110 weighing 377 gms & 65 m long).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 6 1 10.97 10 312° 10 87 Aver. 10.97 miles 31°.2 8.7 lbs. 19

4 Experiment with Oionos Kite, August 4, 1908 .

(Line + 25, no lead; dangling bow-line + 110 weighing 377 gms & 65 m long).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 7 1 10.90 10 296° 10 98 Aver. 10.9 miles 29°.6 9.8 lbs.

(Line + 110, no lead; dangling line + 25 weighing 377 gms & 65 m long).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 8 1 12.39 1 7° 1 2

In this last experiment (exp. 8) the kite was flown by a bow-line and it only supported itself for a sufficient time to enable one observation of altitude and pull to be made. The kite turned half over on its side in the air, and came down sideways, very slowly until it touched the ground.

The kite was then again raised into the air by running with the line in the hope that we might be able to complete a series of observations. The kite however went through the same performance as before coming down gently sideways to the ground. No damage done. This concluded the experiments for the day.

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EXPERIMENTS WITH KITES AUG. 14, 1908: By A. G. Bell.

A good sailing breeze was blowing on Friday, August 14, and Mr. Bedwin was requested by telephone to put up the new Pilot Kite referred to in Bulletin III, p. 23. This kite is of the Frost-King form, of full construction, and constitutes a smaller edition of Kite A (Bulletin 1, 34). It has 12 cells on top, 7 cells to bottom, and is 6 cells high, containing in all 182 winged cells. Weight 4000 gms. Surface 9.851 sq. m oblique. Ratio 406 gms per sq m oblique.

Upon approaching the Laboratory the Pilot Kite was observed in the air flying with great steadiness at a high angle of altitude. It was really a beautiful sight to see this fine structure at rest in the air, supported apparently as immoveable as though glued to the sky.

We had here a good illustration of the wonderful stability exhibited by large tetrahedral kites of full construction when flown in a fully supporting breeze; and the exhibition of stability hammered home the conviction that we should not depart from this form of structure without good and sufficient cause.

A South-West wind of between 15 & 16 miles an hour was blowing at the time, and it was somewhat remarkable that the clouds were moving in quite other directions indicating the presence of three superposed currents of air moving in different directions. The upper layer of clouds moved from W to E the lower layer from E to W, while at the same time the surface wind blew form SW to NE.

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2 The Pilot Kite was flown by a line 105 meters long, weighing 635 gms, attached to a fore and aft bridle which brought the point of attachment practically to a point 37.5 cm in advance of the zero point of the keel-stick, a point half-way between the center of the kite and the front edge of the structure.

Pilot Kite, 1908, Aug. 14

(Main line + 37.5. No bow-line).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 1 1 15.74 5 266° 5 240 Aver. 15.74 miles 53°.2 48.0 lbs.

Advantage was taken of the fine breeze blowing to try the empty Frost-King Kite which we have been unable to test here this season on account of lack wind.

Empty Frost-King Kite, 1908, Aug. 14

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 2 1 14.65 miles

The kite would not sustain itself in the air. Two attempts were made but we could get no instrumental readings. Then the new Kite D was tried (Bulletin V, p. 35)

3 Experiments with Kite D, 1908, Aug. 14 .

(Main line + 50 of Manilla rope 100 m long; bowline + 200 of stout cord 100 m long. The two lines weighed 5628 gms. Flown by main line.

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 3 1 15.37 1st 40° 1st 50 2nd 41° 2nd 55 3rd 36° 3rd 70 4th 35° 4th 45 5th 39° 5th 50 6th 38° 6th 50 7th 40° 7th 60 8th 39° 8th 45 9th 44° 9th 60 10th 41° 10th 45 Total 1 15.37 10 393° 10 530 Aver. 15.4 miles 39°.3 53.0 lbs.

Kite D was not nearly as steady in the air as the Pilot kite. It moved about with wind fluctuations but there was no regular oscillation. Seems to be a good flying kite. Kite D was then flown by the bow-line + 200.

Experiments with Kite D, 1908, Aug. 14 .

(Main line + 50 of Manilla rope 100 m long; bow-line + 200 of stout cord 100 m long. The two lines weighed 5628 gms. Flown by bow-line).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 4 1 11.19 1st 16° 1st 8 2nd 12° 2nd 8 3rd 10° 3rd 15 4th 9° 4th 11 5th 6° 5th 16 6th 5° 6th 9 7th 3° 7th 6 Kite came down. Raised again. 8th 16° 8th 16 9th 13° 9th 14 10th 11° 10th 9 Total 1 11.19 10 101° 10 112 Aver. 11.2 miles 10°.1 11.2 lbs. 23

4 Experiments with Kite C, 1908, Aug. 14 .

(Main line + 50 of Manilla rope 100 m long; bow-line + 200 of stout cord 100 m long. The two lines weighed 5628 gms. Flown by main line).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 5 1st 12.05 1st 23° 1st 40 2nd 19° 2nd 20 Kite came down. Raised again. 2nd 10.00 3rd 24° 3rd 50 4th 23° 4th 40 5th 19° 5th

30 6th 14° 6th 20 7th 16° 7th 35 Kite came down. Total 2 22.05 7 138° 7 235 Aver. 11.0 miles 19°.7 33.6 lbs.

Exp. 6. The attempt was then made to fly Kite A in a wind of 9.54 miles an hour. The kite was not quite self-supporting, but was kept up for some time by careful nursing in hopes of obtaining readings, but ultimately came down, and we then proceeded to try the new White Kite constructed of 50 cm cells with Baldwin's trussing. For photographs of this kite see Bulletin V p. 33.

Experiments with White Kite with Baldwin's Trussing, 1908, August 14.

(Main line + 25 of stout cord 100 m long; bow-line + 100 of stout cord 100 m long. The two lines weighed 1210 gms. Flown by main line).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 7 1st 6.99 1st 29° 1st 3 2nd 30° 2nd 6 3rd 26° 3rd 2 4th 28° 4th 10 5th 24° 5th 5 2nd 6.47 6th 21° 6th 11 7th 29° 7th 8 24 5 Exp. 7 8th 30° 8th 14 9th 35° 9th 3 10th 30° 10th 6 Total 2 13.46 10 282° 10 68 Aver. 6.7 miles 28°.2 6.8 lbs.

This proves to be a light flying kite, but not as steady as desirable. It would fly off the wind to one side, and by and bye fly off the wind to the other side showing a tendency to regular oscillation. It would occasionally tip to one side recovering its equilibrium after a while. Considerable oscillation when near the ground. Landed badly though little if any damage resulted. It should be noticed in defence of the kite that the wind-velocity was not great and that the flying line was attached at a point so near the center of the kite (+ 25) as to place it in the most unfavorable condition for steadiness. Upon the whole we were very much disappointed with the behavior of this splendid looking kite. Certainly we have never made finer looking cells. The nain-sock covering them was stretched tightly and there was nothing baggy about the cells.

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6 <u>Experiments with Oionos Kite, 1908, Aug. 14</u> .

(Main line + 25 of stout cord 100 m long; bow-line + 75 of stout cord 100 m long. The two lines weighed 1210 gms. Flown by main line).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 8 1st 8.27 1st 12° 1st 3 2nd 23° 2nd 10 3rd 33° 3rd 9 4th 34° 4th 5 2nd 8.95 5th 31° 5th 15 6th 22° 6th 7 7th 26° 7th 9 3rd 7.74 8th 25° 8th 12 9th 27° 9th 6 10th 28° 10th 5 Total 3 24.96 10 261° 10 81 Aver. 8.3 miles 26°.1 8.1 lbs.

The Oionos Kite was now taken down. The bow-line was removed and the kite was raised by the main line alone + 25. The line was let out to a length of about 200 m when the following observations were made.

(Main line + 25 of stout cord about 200 m long, and weighed 1210 gms. No bow-line).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 9 1st 10.04 1st 18° 1st 8 2nd 17° 2nd 4 3rd 18° 3rd 8 4th 20° 4th 7 5th 21° 5th 4 6th 24° 6th 10 7th 24° 7th 6 8th 22° 8th 4 9th 20° 9th 7 10th 24° 10th 10 Total 1 10.04 10 208° 10 68 Aver. 10.0 miles 20°.8 6.8 lbs. 26

7 The line was then lengthened until about 300 m were out. The kite seemed to have reached its limit of height, and the line sagged on the ground. Brought kite down. Bad landing. Slight damage to both ends of wing-piece.

The Pilot Kite was then again tried.

Experiments with Pilot Kite, 1908, August 14 .

(Main line + 37.5 of stout cord 100 m long weighing 605 gms. No bow-line).

Wind Altitude Pull Obs Miles Obs Angle Obs lbs. Exp. 10 1st 8.75 1st 37° 1st 20 2nd 35° 2nd 20 3rd 47° 3rd 25 4th 50° 4th 10 5th 45° 5th 25 6th 40° 6th 20 2nd 11.06 7th 44° 7th 20 8th 48° 8th 30 9th 43° 9th 15 10th 45° 10th 30 Total 2 19.81 10 434° 10 215 Aver. 9.9 miles 43°.4 21.5 lbs.

The line was then gradually lengthened, the kite flying at a very high angle until about 300 m had been let out. Before instrumental readings could be taken the flying line broke and the kite floated away coming down slowly. From the Kite-House it seemed as if the kite turned its bow from the wind and glided down at rather a steep angle; in fact it seemed to be making a header. This, however, must have been an optical illusion on account of the distance and point of view, for the kite was found in the public road at some distance outside our entrance gate facing the wind and quite uninjured. Not a single stick was broken so far as we could 27 8 discover. This means a gentle landing with bow depressed, facing the wind so that the drifting of the kite caused the bow to make only a glancing blow on the ground.

Exp. 11. Another attempt was made to raise Kite A without any bow-line in a wind of 9.04 miles per hour. Kite A would not sustain itself in this wind although of similar construction to the Pilot Kite which had just been flown, and of about the same theoretical flying weight. The flying line of Kite A, however, weighed 5121 gms, whereas the line of the Pilot Kite weighed only 605 gms. This concluded the experiments for the day.

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ON HYDROPLANES: by F.W. Baldwin.

(A letter addressed to Mr. J.A.D. McCurdy).

Beinn Bhreagh, Baddeck, N.S., Aug. 12, 1908 :—Aeroplanes have had to give way for a time to hydroplanes. We have retackled the old problem of speed over the water. This time with a view to developing an aerodrome of the water-fowl type, which would start off as a boat, then as she speeds up lift out of the water on hydroplanes, and finally lifting out of the water altogether support herself as a free flying machine. This aerohydric trinity of a boat, a hydroplane, and an aeroplane seems perfectly possible with the engine propellers etc., that we have now.

It has always seemed to me that the hydroplane was worthy of a lot more consideration than it is getting, and that perhaps the greatest speed of locomotion will be over the water in this way.

When speed is the only consideration why should a boat displace water and use up a large part of the engine power in useless wave-making?

The resistance of an ordinary boat when pushed beyond a certain point increases as the cube of the speed. For this reason no substantial increase in the speed of boats has been made for years. The cramming of huge engines into modern racing boats is clearly a misapplication of power when greater speed can be obtained with not more than a quarter of the same power on the hydroplane principle.

Experiments have shown that a boat can be entirely lifted out of the water by very small hydroplanes. This is the 29 2 key to speed. Once a boat can be made to do this her displacement is reduced to a minimum i.e. the vertical component of the pressure on the hydroplanes supports the entire weight of the boat. The hydroplanes themselves have such a small displacement that it may be fairly considered as negligible. Speed then is simply a question of lift and drift comparable to the aeroplane.

The resistance will not increase with the speed because as the speed increases the same propeller thrust will sustain the boat upon a smaller surface of hydroplanes. The limit of speed therefore will be determined by the resistance the hull meets with not in the water but in the air. This at high speeds for a motor boat is not very great, and as it increases only as the square, and not as the cube of the speed the limit will be very much higher for a boat with a given horse-power when hydroplanes are used in this way. The lifting out of the hydroplanes from the water amounts to the same thing as reefing them.

Sometime ago I resolved the forces acting on a hydroplane and by a little trigonometrical juggling arrived at the conclusion that the water resistance was directly proportional to the weight of the boat and did not depend in any way upon the velocity. Of course this conclusion involved a few assumptions which I was not sure of at the time, and the result seemed so startling as hardly to warrant them. However recently in L'Aerophile M. Forlanini makes the statement that the resistance of a hydroplane boat is practically independent of the velocity and equal to about 1/12th of the weight in his 30 3 apparatus up to speeds of over 40 miles an hour. Beyond this the air resistance becomes a limiting factor.

These results are very encouraging when we consider the simplicity of the arrangements, the relatively low power and the tremendous lift exerted by the hydroplanes.

M. Forlanini uses a 75 horse-power engine geared to two large aerial propellers one in the bow and one in the stern turning in opposite directions. The propellers each have five blades 1.7 meters diameter, and a pitch of 6 meters. The hydroplanes are on a kind of a rack extending from either side of the boat and arranged in superposed fashion like a Venetian Blind, so that as the boat lifts out of the water the submerged hydroplane area is proportionally reduced. The planes are very narrow from fore to aft and he states that at a speed of 70 kilometers an hour the entire weight of the boat (1650 kg) was supported upon a surface of only .125 square meters. This gives the astonishing result that one square meter is sufficient to support 11 metric tons at this speed. (11000 kgs).

Now judging from these figures I think we should be able to get some good results with the little catamaran on which we have been trying out some hydroplanes.

The Edbert carrying a man and with the four cylinder 20 horse-power motor, and the 1.5 meter propeller weighs about 500 lbs. The thrust can safely be counted on as 90 lbs., and this according to M. Forlanini is more than twice what we need to obtain high speed.

(Signed) F.W. Baldwin.

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BALDWIN'S HYDROPLANE EXPERIMENTS WITH THE CATAMARAN EDBERT: by A.G. Bell.

On Wednesday, Aug. 5, 1908, the old twin boat “Edbert” was fitted with the Curtiss No. 2 motor for an experiment which F.W. Baldwin desired to try. A propeller was attached directly to the engine-shaft. It was 150 cm in diameter having an angle of 17° ½ at the tip; the pitch equalled the diameter. On account of the size of the propeller the engine had necessarily to be placed high up above the floats. The center of gravity of the engine must have been at least one meter above the floats. A pushing propeller was used so it was brought aft and Mr. Baldwin proposed to sit under the engine, but there was hardly room for him to escape the balance wheel. The rudder was in front. Mr. Baldwin proposed to see what speed the “Edbert” would attain when propelled by an aerial propeller and then attach two hydroplanes below the boat to test her as a hydroplane boat. The information gained would be of value in relation to an aerodrome we propose to make employing a winged structure of the Oionos type. The aerodrome to be placed upon floats and to rise out of the water when propelled by its own motive power. Mr. Baldwin thinks that submerged hydroplanes will assist the process of rising.

Experiments with the Edbert, Aug. 5, 1908 .

Exp. 1. The Edbert having been fitted with its engine and propeller, Mr. Baldwin got on board; but he could not crank the engine while sitting below it, and so stood up in front in order to crank it. This depressed the bow of the boat so that it was lower than the stern and the moment the engine was 32 2 started the propeller, rotating I should think at least 1200 times a minute if not more, caused the boat instantly to shoot forwards, and bury her bows. Before anything could be done the boat turned over forwards and sideways in the water. Mr. Baldwin shut off the power as the boat went over which was fortunate as the balance wheel grazed his arm and made an ugly bruise which might have been serious had the balance wheel been in full rotation. The Edbert turned upside down in the water as Mr. Baldwin succeeded in swimming clear.

Some difficulty was experienced in righting the boat and the greater part of the afternoon was occupied in trying to get the engine to run again. Three of the cylinders seemed to work well but the fourth (No.2) was as Mr. Baldwin expressed it “dead”. However, it was determined to make another experiment with the three cylinders in operation leaving the fourth to be repaired next day.

Experiment with the Edbert, Aug. 5, 1908 .

Exp. 2. The Edbert was fitted with hydroplanes consisting of two thin wooden boards each 138 × 20.5 × 0.5 cm. These were set at an angle of 14°48“ with the bottom of the boat. The rudder was shifted to the stern and a wooden guard was placed below the balance wheel to prevent any accidental contact with it while in rotation.

The boat was brought to the end of the little wharf at the aerodrome shed; and Mr. Bedwin lay down upon the wharf and held the boat by the stern when the engine was started to prevent the boat from shooting off before Mr. Baldwin could take his proper position in the boat. Mr. Baldwin stood up in the 33 3 boat to crank the engine. After many unsuccessful attempts he succeeded in getting the three cylinders to work and poor Mr. Bedwin with his head within a couple of feet of the rapidly rotating propeller looked as if he would have his hair blown off by the powerful draught of air while he held the boat in position. Mr. Baldwin then carefully crept into his position under the engine and stuck his head out under the balance wheel guard. (see page 12) It was fortunate that the guard was there otherwise in his eagerness to try the experiment he might perhaps have succeeded in decapitating himself. When Mr. Baldwin was in position he gave the signal to Mr. Bedwin to let go, and the boat shot out. The Edbert went a distance of, I should think, about three hundred meters, but the speed was not sufficient to cause any marked hydroplane action, at least I could not perceive that the boat rose in the water when propelled. Mr. Baldwin then carefully steered the boat round in a wide circle, fortunately without upsetting, and continued back to near the wharf where the engine was stopped.

Further experiments were then postponed until the engine could be put in good order again. The rotation of the propeller was much less than with all four cylinders in operation. This ended the experiments for the day.

Experiments with the Edbert, Aug. 6, 1908 .

Following changes have been made in Edbert hydroplane boat since the last experiments of Aug. 5.

The engine has been lowered and slightly tilted down at rear. It has been lowered as much as possible without blade touching water. The blade of the propeller was probably not 34 4 more than about two inches from the water.

Angle of hydroplanes reduced from 14°48“ to 5°43“. Engine thoroughly cleaned. Process of starting same as in Experiment 2 (Aug.5).

Experiments with Edbert, Aug. 6, 1908 .

Exp. 1. Engine s y t arted, Mr. Baldwin took his seat as before, while Mr. Bedwin held the stern of Edbert from wharf. When released Edbert started off well gradually gathering speed. The word “Edbert” which was close to water surface when she left the wharf, (1) rose up as she gathered speed until nearly the whole of the hull at the bow was exposed. (2) This depressed the stern so much that the edge of the propeller struck the water and the propeller smashed in two. Mr. Baldwin at once shut off the power, and the bow fell to its original position (1). There can be no doubt that the hydroplanes, at their reduced angle, lifted the boat. Fortunately the engine does not seem to have been injured, and we have other propellers we can try.

Experiment with Edbert, Aug. 8, 1908 .

On Saturady Aug. 8, Mr. Baldwin continued his experiments with hydroplanes. Changes in apparatus since last experiment (Aug.6). Engine thrust horizontal. New propeller 140 cm diameter. This was made from an old propeller 150 cm diameter and 17° ½ at tip, the ends were cut down and rounded so propeller only 140 cm diameter now).

Three hydroplanes each 138 × 20.5 × 0.5 cm were attached each making an angle of 5°43‘ with the bottom of the boat.

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5 <u>Experiments with Edbert Aug. 8, 1908</u> .

Exp. 1 Testing the pull. Mr. Baldwin went on board the Edbert and started the engine while Mr. Bedwin held the boat from the wharf. Only three cylinders working well, pull 60 lbs. After some fussing over the engine and blowing out of carbuatters all four cylinders started off well. The pull of the Edbert went up at first to 90 lbs. and then settled down to a steady 85 lbs. This was considered fairly satisfactory. Exp. 2 Another experiment gave 480 rotations of the propeller in ½ minute with a pull of 70 lbs., but Mr. Baldwin thinks that the speed-indicator reading was unreliable.

Exp. 3 Edbert then taken out into harbor to test effect of hydroplanes. Under action of aerial propeller the stern rose and the head was depressed, so that Baldwin fearing another upset like the first, shut off the power. There can be no question that the boat was lifted by the action of its hydroplanes.

Exp. 4 The angle of the bow hydroplane was then increased to 11°19‘, the other two hydroplanes remaining at angle 5°43‘. Result was very promising. Boat undoubtedly rose when propelled and more on even keel. Rain stopped further experiments.

Experiments with Edbert Aug. 10, 1908.

The wind was too strong in the harbor to do much with the Edbert. About 5 o'clock it had moderated somewhat and we tried her with an additional hydroplane under the bows, making four hydroplanes in all. (Towed by the Gauldrie). At speed of about 4 miles an hour she succeeded to lift about 2 inches at the bow and about 4 inches at the stern. The speed however was not satisfactory.

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6 Experiments with Edbert Aug. 11, 1908 .

Edbert tried at Laboratory to-day with four hydroplanes Bow hydroplane 135 × 15 × 0.5 cm. The three others each 138 × 20.5 × 0.5 cm. All being set at an angle of 8°32#.

Exp. 1 Engine removed and replaced by load of lead. Mr. Baldwin went on board Edbert which was towed by the Gauldrie so as to produce a pull of between 80 and 90 lbs. This was done so successfully that 40 successive observations of pull gave 90 lbs each time. The speed of the Gauldrie in producing this pull was 400 m in 3 minutes and 40 seconds, or 6.545 kilometers per hour.

Exp. 2 Angle of hydroplanes changed to 14°2#. Twenty-one observations gave an average pull of 89.8 lbs. (3 observations at 85 lbs; 17 observations at 90 lbs; and 1 observation at 100 lbs). Speed of the Gauldrie was 400 m in 3 minutes and 50 seconds, or 6.261 kilometers per hour.

Exp. 3 Angle same as in experiment 2, namely 14°2#. Nineteen observations gave an average pull of 91.3 lbs. (1 observation at 85 lbs; 13 observations at 90 lbs; 4 observations at 95 lbs; and 1 observation at 100 lbs). Speed of the Gauldrie was 400 m in 3 minutes and 45 seconds, or 6.418 kilometers per hour.

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6 7 Experiments with Edbert Aug. 13, 1908 .

The Edbert, with hydroplanes below the bottom, was towed to-day by the Gauldrie at various speeds with the following results:—

Exp. 1 Four hydroplanes at 5°. Speed with wind 10.3 km per hr. Pull 80 lbs.

Exp. 2 Four hydroplanes at 5°. Speed against wind 9.2 km per hr. Pull 80 lbs.

Exp. 3 Four hydroplanes at 20°. Speed with wind 7.6 km per hr. Pull 90 lbs. Pull at full speed 120 lbs.

Exp. 4 Four hydroplanes at 20°. Speed against wind 6.9 km per hr. Pull 85 to 90 lbs.

Exp. 5 Four hydroplanes at 0°. Speed with wind 8.9 km per hr. Pull 75 to 80 lbs. Pull at full speed 90 lbs.

Exp. 6 Four hydroplanes at 0°. Speed against wind 9.0 km per hr. Pull 90 lbs. Pull at full speed 90 lbs.

Exp. 7 Two hydroplanes at 0°. The intermediate hydroplanes were removed. The bow and stern planes alone being kept. Speed with wind 10.3 km per hr. Pull 75 lbs.

Exp. 8 Hydroplanes all removed. Speed against wind 9.3 km per hr. Pull 35 lbs.

NB The bottom of the boat itself made an angle of about 5° with the water line when at rest, so that it might perhaps be well to consider the above angles of the hydroplanes as 5° greater than noted.

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BALDWIN'S EXPERIMENTS WITH THE “DHONAS BEAG”,AUG. 19, 1908 By A. G. Bell.

The new hydroplane boat now being constructed according to the plans of Mr. F.W. Baldwin was tried (without the hydroplanes which are not t y et quite completed) Aug. 19, 1908. A photograph of the structure in its present condition is appended. The hull weighs 51 lbs, the two out-rigger floats together 5 lbs, the truss to support the floats 7 lbs, the engine-bed 10 lbs, and the engine and accessories 145 lbs. If we include the weight of a man as 170 lbs the whole structure, with man and engine (but without the hydroplanes) weighs 388 lbs.

In the experiments made Aug. 19, 1908 the hull was loaded with lead to represent the engine etc. so that the whole weight of the structure with Mr. Baldwin on board was about 388 lbs.

The boat was towed by the Gauldrie at the rate of 13 kilometers per hour (12.973) and when it was found that the strain on the towing-line was less than 11 lbs., one of our Gaelic workmen ejaculated "Dhonas Beag" (little devil). This took Mr. Baldwin's fancy and he has accordingly named his boat the "Dhonas Beag".

(see lower photograph on p. 13)

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Experiments with the "Dhonas Beag", August 19, 1908.

Pulls Speed Remarks Summation Average obs lbs lbs in km per hr Exp. 1 17 185 10.9 12.973 with wind. Exp. 2 15 297 19.8 13.091 against wind. Exp. 3 18 322 17.9 13.091 with wind. Exp. 4 13 381 29.3 12.743 against wind. Exp. 5 14 201 14.4 10.827 with wind. Exp. 6 12 217 18.1 10.667 against wind. Exp. 7 15 236 15.7 10.909 with wind. Exp. 8 15 295 19.7 10.992 against wind. Exp. 9 14 267 19.1 11.803 with wind. Exp. 10 12 261 21.7 11.339 against wind. Exp. 11 13 211 16.2 11.613 with wind. Exp. 12 14 310 22.1 12.000 against wind.

Full confidence in the above results cannot be entertained on account of the puffy wind in Beinn Bhreagh Harbor. During the experiments the wind as noted on the kite field above varied from 9.08 miles per hour to 12.05 miles. The wind was about West and was extremely fluctuating in the partially sheltered harbor.

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BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

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BULLETIN NO. VIII ISSUED MONDAY AUGUST 31, 1908 .

Beinn Bhreagh , Near Baddeck , Nova Scotia .

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EXPERIMENTS WITH KITES AUGUST 19, 1908: by A. G. Bell

Exp . 1 . An attempt was made to-day (Aug. 19) to fly kites A and D simultaneously in a wind of 9.08 miles per hour. Kite A was first put up, and would barely support itself. In spite of nursing it came down before Kite D could be raised. In a similar manner Kite D could not be kept up long enough to enable Kite A also to be raised.

It had been our intention to fly both at the same time, and see which would come down first, but we could not get them both up at the same time in the wind noted.

Have come to the conclusion that the flying-lines of Manilla rope are too heavy for these kites in the ordinary winds we have here, while the stout cords used for bow-lines are too weak, and we have no half way. The towing-line used in the hydroplane experiments seems to be more suitable. It is made of the sort of cord employed to form the nets into which athletes and acrobats leap from a height. Mr. Bedwin says it is reported that this sort of cord will stand a strain of 500 lbs., which I very much doubt. If he is correct it is just the sort of cord we want, for its strength would be abundantly sufficient for our purpose, while its weight would be only a fraction of the weight of the quarter inch Manilla rope now employed.

Exp . 2 . Tried the Pilot Kite in a wind of 11.20 miles per hour with two lines of stout cord, one attached at + 37.5 cm with the other as a bow-line at + 175 cm. We were very much surprised at the behavior of the kite under these conditions. 2 In former experiments the Pilot Kite had flown with wonderful steadiness “as though glued to the sky”, and at a very high altitude (55°), but now the kite went off the wind to the left (Starboard of the kite) exhibiting a ??? ten dency to dive to that side. It then recovered itself, and went to the right of the wind (port side of kite). Recovering itself it went through the whole performance again and again, oscillating from side to side like the swing of a pendulum. The only hopeful feature seemed to be that the kite would occasionally fly steadily for a considerable period of time. Then would come another period of oscillation followed by a steady flight etc. When a slight departure to one side occurred the deviation increased very rapidly as though the kite had been steered to that side.

Examining the kite closely to find out what it could be that occasioned the steering action, it appeared probable that the bow-line was the effective agent. When the keel-stick did not point directly in the wind's eye the weight of the bow-line, and the pressure of the wind upon it, acting through the leverage of the long bow, might have been sufficient to produce the effect, and I could see no other cause for the difference in the behavior of the kite from that observed in former experiments, in which no bow-line had been used .

One swoop of the kite to the left led to a side dive of great extent. A strain was immediately exerted on the bow-line, but we were unable to save the kite from a side-header right to the ground. The shock of alighting was probably lessened, however, by the tension on the bow-line as only 3 slight damage resulted, and we were able to put the kite up again immediately.

Exp . 3 . The bow-line was removed, and the Pilot Kite was then raised by the other line alone attached at + 37.5 cm The kite now flew perfectly steadily as on former occasions without any apparent tendency to side motion, and at a very high angle probably 55°, which was the highest angle noted before. The wind was from the West; velocity 12.05 miles per hour.

This demonstration that the bow-line had been the cause of the side-diving noticed in experiment 2 is a new point, and is of importance as indicating that a slack bow-line may be a dangerous feature in a kite:— I mean a bow-line hanging slack while the kite is supported on another line further back. The pressure of the wind on the bow-line combined with the weight of the line, and the leverage exerted on the kite through the length of the bow tend to steer the kite off to one side when the bow-sprit is not pointing directly into the wind.

As Mr. Bedwin and Mr. Baldwin were engaged at the time in hydroplane experiments in Beinn Bhreagh Harbor, we had no one present in the kite-field accustomed to reading the clinometer. Mr. Rudderham and I both tried our hands, but, as this was our first attempt the results may not be very accurate. We made 10 observations of altitude which yielded an average of 45°.4. No observations of pull were made, but a reading of the anemometer gave a velocity of 9.15 miles per hour at the conclusion of the experiment.

4

Exp . 4 . An attempt was then made to fly the Pilot Kite from a point + 75 cm from center of kite (the front edge of the kite structure). The Pilot Kite just supported itself and no more. We could not keep it up long enough for instrumental observations. This finished the kite experiments for the day.

5

EXPERIMENTS WITH KITES AUGUST 20, 1908: by A. G. Bell.

There was a strong wind from the West this morning (Aug. 20), and although it had died down by the afternoon a good deal we were able to make quite a number of series of experiments with different kites. For the first time we have been able to have both Kite A and Kite D in the air at the same time so as to make direct comparisons accompanied by instrumental observations. The results seem to have an important bearing upon the form of tetrahedral construction to be adopted in aerodrome No.5.

Exp . 1 . Kites A and D were both raised into the air without bow-lines. Each was flown by a one quarter inch Manilla rope 100 m long, weighing 5121 gms, attached at + 50 cm from center of keel-stick. Observations were then made upon Kite D.

D. KITE D.

Exp. 1. Altitude Pull Wind 45° 35 38° 25 40° 25 30° 20 Kite A here came down. 40° 20 30° 20 9.86 miles 22° 17 Kite D here came down. 7 Obs 245° 162 Aver. 35°.0 23.1 lbs.

Kites A and D were again raised into the air simultaneously by nursing and both remained flying. The following observations were then made with Kite D:—

6

Experiments with Kite D. August 20, 1908 :—

Exp. 2. Altitude Pull Wind 36° 35 38° 35 43° 40 44° 40 40° 40 9.46 miles 45° 40 45° 25 38° 35 43° 35 40° 30 10 Obs. 412° 355 Aver. 41°.2 35.5 lbs.

Kite A fell very gently to the ground after these observations on Kite D had been made, leaving Kite D in the air. Shortly afterwards Kite D also fell. Kites A and D were then again raised simultaneously and the following readings were obtained with Kite A.

Experiments with Kite A, August 20, 1908 :—

Exp. 3. Altitude Pull Wind 30° 70 25° 35 32° 40 24° 30 19° 30 9.80 miles 17° 25 10° 20 11° 25 8 Obs 168° 275 Aver. 21° 34.4 lbs.

After the 8th observation Kite A came down leaving Kite D in the air flying, as Baldwin expressed it “without a whimper”. Kite A was then again raised by running while Kite D was still in the air.

7

Exp. 4. Experiments with Kite D, August 20, 1908 .

Altitude Pull Wind 52° 30 53° 30 51° 25 49° 30 13.15 miles 44° 20 36° 20 43° 40 42° 30 45° 35 46° 45 10 Obs 461° 305 Aver. 46°.1 30.5 lbs

Kite A remained in the air while the above observations on Kite D were being made; and the following observations were then made upon Kite A, leaving Kite D still flying.

Experiments with Kite A, August 20, 1908 .

Exp. 5. Altitude Pull Wind 27° 35 31° 50 32° 30 32° 55 39° 45 40° 35 38° 25 12.70 miles 33° 25 34° 30 25° 20 10 Obs 331° 350 Aver. 33°.1 35.0 lbs

Kite D remained in the air during experiment 5. At the conclusion of the series of the observations Kite A came down leaving Kite D still flying. There can be no manner of question that Kite D is a lighter flying kite than Kite A.

8

Comparison of Kite D with the Pilot Kite .

Leaving Kite D still flying, the Pilot Kite, without a bow-line was raised into the air by a cord 100 m long weighing 495 gms attached at point 37.5 cm from center of kite.

Experiments with Pilot Kite, Aug. 20, 1908 .

Exp. 6. Altitude Pull Wind 58° 40 49° 25 53° 35 57° 35 51° 20 14.76 miles 50° 30 47° 30 43° 35 42° 45 43° 30 10 Obs 493° 325 Aver. 49°.3 32.5 lbs

Both Kites still remaining up, observations were then made on Kite D.

Experiments with Kite D, August 20, 1908 .

Exp. 7. Altitude Pull Wind 30° 25 32° 30 31° 30 35° 35 40° 90 8.98 miles 33° 30 32° 50 43° 50 42° 30 39° 25 10 Obs 357° 395 Aver. 35°.7 39.5 lbs. 9

Comparison of Kite D with Kite A .

The Pilot Kite which had been flying while experiment 7 was made was now taken down leaving Kite D still in the air, and Kite A was raised by running.

Experiments with Kite A, August 20, 1908 .

Exp. 8. Altitude Pull Wind 40° 30 42° 50 30° 30 35° 40 40° 60 44° 70 12.45 miles 40° 65 40° 65 42° 55 39° 70 10 Obs 392° 535 Aver. 39°.2 53.5 lbs

Kite A then came down leaving Kite D flying well. Kite D, remaining alone in the air, the following observations were then made:—

Experiments with Kite D, August 20, 1908 .

Exp. 9. Altitude Pull Wind 35° 40 48° 45 55° 40 9.81 43° 30 35° 20 34° 40 24° 30 38° 40 35° 30 38° 25 10 Obs 385° 340 Aver. 38°.5 34.0 lbs. 10

Comparison of Kite D with the old Victor Kite .

Kite D still remaining in the air we put up a White Victor Kite which has been preserved for some years as a model. It was flown by a bridle centering on point + 75 cm from center of kite.

Experiments with the Victor Kite, Aug. 20, 1908 .

Exp. 10. Altitude Pull Wind 40° 20 35° 20 37° 25 38° 20 11.06 miles 34° 15 40° 20 47° 30 53° 40 50° 25 46° 45 10 Obs 420° 260 42°.0 26.0 lbs

The Victor Kite and Kite D being still both in the air observations were then made on Kite D.

Experiments with Kite D, Aug. 20, 1908 .

Exp. 11. Altitude Pull Wind 48° 40 42° 40 35° 50 42° 60 13.10 miles 41° 40 41° 30 46° 50 52° 50 48° 40 45° 50 10 Obs 440° 450 Aver. 44°.0 45.0 lbs. 11

Exp . 12. . The Victor Kite was now taken down and the flying-rope attached at + 50 cm. It was then raised again, Kite D flying all the time. Before observations could be made the wind lulled and both kites came down.

Experiments with the White, 50 cm celled Kite with Baldwin's Trussing .

Experiments were then made with the White, 50 cm celled kite with Baldwin's Trussing without any other kites in the air at the same time. The White Kite was flown by a cord 100 m long weighing 495 gms, attached + 50 cm from center of kite (the front edge of the kite structure).

Experiments with White Kite, August 20, 1908 .

Exp. 13. Altitude Pull Wind 28° 9 26° 6 22° 3 25° 5 10.88 miles 30° 6 34° 6 33° 6 37° 4 28° 9 27° 5 10 Obs 290° 59 Aver. 29°.0 5.9 lbs.

The White Kite seemed to fly pretty steadily upon the whole although considerable swaying occurred during fluctuations of wind. Several times the kite tipped over to one side like a vessel on her beam ends with shifted cargo. After flying pretty steadily for some time "on her beams 12 ends", she righted again until the next upset occurred. She is certainly a light flying kite. We began to bring her down steadily on even keel, but unfortunately she was too near the Kite-house, and came into the wind-shadow of the building. At once she tipped over on her beams ends and came down gently in that position striking the ground with her wing tip, breaking the end cell. This finished the kite experiments for the day.

While the above experiments with Kites were being made Mr. Baldwin made experiments on Beinn Bhreagh Harbor to test the stability of the "Dhonas Beag", but I have no records, having been on the kite field making experiments 8–13.

The following tables give a summary of the experiments with Kites A and D, August 20, 1908, and the averages deduced from them:—

13

Experiments with Kites A and D, August 20, 1908 .

Summary for Kite A .

	Wind		Altitude		Pull	
	Obs	Miles	Obs	Angle	Obs	lbs.
Exp. 3	1	9.80	8	168°	8	275
Exp. 5	1	12.70	10	331°	10	350
Exp. 8	1	12.45	10	392°	10	535
Summation	3	34.95	28	891°	28	1160

Summary for Kite D .

	Wind		Altitude		Pull	
	Obs	Miles	Obs	Angle	Obs	lbs.
Exp. 1	1	9.86	7	245°	7	162
Exp. 2	2	17.54	10	412°	10	355
Exp. 4	1	13.15	10	461°	10	305
Exp. 7	1	8.98	10	357°	10	395
Exp. 9	1	9.81	10	385°	10	340
Exp. 11	1	13.10	10	440°	10	450
Summation	7	72.44	57	2300°	57	2007

Averages for Kites A and D

	Wind	Altitude	Pull
Kite A	11.65 miles	31°.8	41.4 lbs
Kite D	10.35 miles	40°.4	35.2 lbs

As a general result it will be observed that Kite D flew, in less wind, at a higher angle than Kite A, and with less pull. Kite D has certainly demonstrated its superiority over Kite A.

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EXPERIMENTS WITH KITES A AND D, WITH KITE D LOADED TO MAKE IT EQUAL IN WEIGHT TO KITE A; AUGUST 21, 1908:— by A. G. Bell.

The experiments of yesterday (Aug. 20) satisfied me at the time that the hollow type of construction typified by Kite D was superior to the full construction (typified by Kite A) in large structures.

When both Kites were in the air at the same time, Kite D flew at a higher angle than Kite A, and with less pull; and Kite D continued flying in winds that would not support Kite A. These observations demonstrated that Kite D was a lighter-flying structure than Kite A in spite of the fact that it had fewer cells, and a greater (theoretical) flying-weight.

In regard to steadiness too the behavior of Kite D was satisfactory. It certainly seemed to respond to wind fluctuations more quickly than Kite A, but there was nothing to indicate any inherent instability. Kite A reminded me of a water-logged vessel, and Kite D of a cork dancing upon the waves.

This water-logged, or logey appearance of Kite A may perhaps have been due to the presence of inefficient cells in the interior of the kite. Perhaps after all a cork-structure may be safer in an emergency than a water-logged vessel; and the weight of a man and an engine in a structure of the D type would probably act as a steadier quite as well as inefficient cells. It is doubtful whether increased stability due to a water-logged, or rather “air-logged” condition is a desirable feature in a Kite. Even though it should be desirable 15 from the stability point of view, it is certainly not desirable from the point of view of efficient support in the air.

The above considerations led me to decide upon the D type of construction for aerodrome No. 5, and I gave orders this morning (Aug. 21) to begin the assembling of the materials of the new aerodrome upon this plan, as soon as the old structures which now encumber our buildings have been taken to pieces so as to leave room for the aerodrome and for Kites built upon the same design.

Later in the day I became somewhat uneasy at the thought that Kite D might perhaps have owed its superiority over Kite A to its lightness, rather than to the arrangement of its cells. The Pilot Kite, though of similar construction to Kite A, and having about the same theoretical flying-weight, was much superior to it in the winds we tried, and this superiority was attributed to the less load it carried in the form of flying-lines. Kite D carried the same load of rope, and had beading of equal weight to that of Kite A, but owing to the omission of interior cells the Kite structure itself was lighter. To test the matter Kite A and D were again sent up to-day (Aug. 21) after loading Kite D to make it of equal weight with Kite A.

The two Kites, with their flying-lines, were first carefully weighed in my presence with the following results:— The two flying-ropes together were 222.7 meters in length, and weighed 9600 gms. The flying-line of 100 meters carried by each kite therefore weighs about 4311 gms.

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Kite A weighed 9267 gms.

Kite D weighed 7603 gms.

difference 1664 gms.

Experiments with Kites A and D August 21, 1908 .

A bag of sand weighing 1664 gms was fastened to the center of the keel-stick of Kite D so as to make it weigh 9267 gms., which was the weight of Kite A. Then Kites A and D were raised simultaneously into the air and the following observations were made upon Kite D.

Kite D .

Altitude Pull Wind Exp. 1. 40° 40 41° 50 43° 30 39° 40 35° 30 13.52 miles 36° 30 35° 20 31° 40 35° 50 36° 40 10 Obs 371° 370 Aver. 37°.1 37.0 lbs.

At the conclusion of these observations Kite A came down leaving Kite D flying well. Kite A was then raised again by running with the line. Wind 11.30 miles per hour, but this proved not sufficient to sustain Kite A in the air, although Kite D remained flying well all the time. It seemed un-necessary to make another attempt as the information desired had been already obtained.

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Kite D, when loaded, so as to make it of the same weight as Kite A, still showed itself to be a lighter-flying kite than Kite A. It was supported in a wind that would not sustain A; and, when both kites were in the air at the same time, it was obvious to the eye that Kite D flew at a higher angle. The flying-lines were similar in length and weight, and were attached at similar points in the two kites. The beading and the keel-sticks were of the same weight, and the Kite structures themselves, owing to the bag of sand carried by Kite D were also equal in weight. The only difference was in the number and arrangement of the cells. To this difference of structure alone, therefore, Kite D owed its superiority.

I have found no reason to alter my decision of this morning that the D type of structure should be adopted in aerodrome No. 5, and the assembling of the material will at once be begun.

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BEDWIN'S EXPERIMENTS WITH THE EMPTY FROST-KING KITE AUGUST 21, 1908: by A. G. Bell.

We have hitherto been unsuccessful in our attempts to fly the old Empty Frost-King Kite. We could raise it into the air, but, upon all the occasions when the experiment was made, the wind proved insufficient to keep it up. Needing room for new structures, I sent down word to the Laboratory this morning (Aug. 21) to have the kite taken to pieces, but later in the morning, finding that a good wind was blowing, I telephoned to Mr. Bedwin to give the kite a final trial before taking it to pieces. The message arrived just in time. The men had begun to strip off the beading, but this was soon replaced, and the old empty Frost-King Kite was given its last chance at flight. The wind fortunately proved sufficient to sustain it, and we have at last secured instrumental data concerning its behavior in the air. At the conclusion of the experiments the process of demolition was resumed and the old Frost-King Kite is now no more.

The following is Mr. Bedwin's report concerning this morning's experiments.

Experiments with Empty Frost-King Kite August 21, 1908.

We tried to put the Kite up with both bow and flying-lines but could not get it to rise. Then took bowline off and kite went up. The line was of Manilla rope one quarter inch diameter and 100 meters long attached at point 19 + 75 cm on keel-stick. Wind very unsteady and even the Pilot Kite, which we had up at the same time, seemed wobbly in the air.

Experiments with Frost-King Kite .

Exp. 1 Altitude Pull Wind 38° 200 37° 250 39° 230 31° 150 9.48 miles 35° 150 31° 120 29° 200 28° 150 25° 150 30° 140 10 Obs. 323° 1740 Aver. 32°.3 174.0 lbs Exp. 2 Altitude Pull Wind 28° 150 15° 40 17° 60 25° 150 30° 150 12.78 miles 34° 100 22° 50 38° 300 32° 140 34° 200 10 Obs 275° 1340 Aver. 27°.5 134.0 lbs 20 Exp. 3. Altitude Pull Wind 35° 200 34° 150 32° 170 31° 150 32° 110 28° 150 17.04 miles 30° 150 31° 110 28° 150 30° 160 10 Obs 311° 1500 lbs Aver. 31°.1 150.0 lbs Exp. 4 Altitude Pull Wind 37° 200 32° 170 31° 130 30° 110 31° 120 13.04 miles 25° 110 22° 70 20° 40 10° 30 10° 28 10 Obs 248° 1008 Aver. 24°.8 100.8 lbs

The kite came down herself just after last reading (exp.4). Tried to put her up again, but there was such a terrific squall that the scale registered over 500 lbs., and the fastening of the scale broke, letting the strain come on to the slack line attached to the cleat. The sudden jerk pulled the inners out of the kite, and she came down to the ground. (W.F.B.)

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Empty Frost-King Kite, August 21, 1908 .

Summary of Observations .

Altitude Pull Wind Obs Angle Obs lbs Obs Miles Exp. 1 10 323° 10 1740 1 9.48 Exp. 2 10 275° 10 1340 1 12.78 Exp. 3 10 311° 10 1500 1 17.05 Exp. 4 10 248° 10 1008 1 13.04 Summation 40 1157° 40 5588 4 52.35 Average 28°.9 139.7 lbs 13.1 miles 22

BEDWIN'S EXPERIMENTS WITH KITES A, C, & D, AUGUST 22, 1908: by A. G. Bell.

Windy days at Beinn Bhreagh are few and far between, and I am therefore much indebted to Mr. Bedwin and Laboratory staff for their assiduity in collecting Kite data to-day for my use while they had the chance. Exceptionally good wind conditions prevailed which were utilized to the uttermost. More than one thousand instrumental observations were made.

Wind 56 Observations

Altitude 560 Observations

Pull 560 Observations

Total 1176 Observations.

The data collected are important and valuable, and will afford much food for study. The object of the experiments was to accumulate data concerning the effects produced by varying the point of attachment of the flying-line; and especially to note the results of flying by the bow at a low angel for use in calculating the engine-thrust required to support kite structures in the air. It was my desire that as many observations as possible should be made with Kite D as typical of the structure to be employed in the tetrahedral aerodrome No.5, and also a few observations of Kite A for purposes of comparison.

The experiments with Kite D were commenced about 10 A.M. and continued until noon when the Laboratory staff adjourned for dinner. Unfortunately the Kite was not taken down at this time, but was left flying with the intention of 23 resuming the experiments after dinner. About half-past twelve o'clock the men in the Kite-House heard a curious whistling noise outside apparently proceeding from the kite and rushed out to see what was the matter. They were just in time to see the kite dive head first to the ground. The bow struck with such force that the keel-stick was driven almost through the structure completely wrecking the kite. In this way Kite D has come to an untimely end. In the afternoon a comparison series of observations was taken with Kite A, after which as Kite D could no longer be used, several sets of observations were taken with Kite C, as the nearest approach to the desired form of structure although Kite C was in a badly damaged condition from former experiments, and had not been repaired. It is somewhat remarkable under the circumstances that Kite C flew steadily and well, and it will be interesting to note how the records compare with the other kites. The experiments ended at 5 P.M.

The records obtained are so voluminous that only the summaries and averages can be here presented:—

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Bedwin's Experiments with Kite D, August 22, 1908 .

Summary of Observations.

Kite D	flying line		Altitude		Pull		Wind	
	Kind	Place	Obs	Angle	Obs	lbs	Obs	Miles
Exp. 1	cord	200+	10	72°	10	180	1	11.60
Exp. 2	cord	175+	10	112°	10	254	1	17.05
Exp. 3	cord	150+	10	172°	10	285	1	14.16
Exp. 4	cord	125+	10	215°	10	295	1	14.65
Exp. 5	cord	100+	10	290°	10	405	1	16.06
Exp. 6	rope	75+	10	308°	10	450	1	16.55
Exp. 7	rope	50+	10	446°	10	665	1	14.92
Exp. 8	rope	50+	10	409°	10	630	1	15.80
Exp. 9	rope	75+	10	306°	10	405	1	13.30
Exp. 10	cord	100+	10	290°	10	390	1	13.65
Exp. 11	cord	125+	10	208°	10	290	1	11.60
Exp. 12	cord	150+	10	138°	10	248	1	13.10
Exp. 13	cord	175+	10	112°	10	220	1	14.35
Exp. 14	cord	200+	10	78°	10	216	1	15.60
Exp. 15	cord	200+	10	97°	10	242	1	16.25
Exp. 16	cord	175+	10	114°	10	345	1	17.45
Exp. 17	cord	150+	10	167°	10	335	1	15.35
Exp. 18	cord	125+	10	227°	10	395	1	15.85
Exp. 19	cord	100+	10	278°	10	315	1	13.40
Exp. 20	rope	75+	10	274°	10	430	1	15.05
Exp. 21	rope	50+	10	425°	10	565	1	12.20

Note:— Wind very steady and the Kite flew steadily in all the experiments. While we were absent at dinner the kite dived to the ground and was smashed. The experiments were then resumed with Kite A. (W.F.B).

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Bedwin's Experiments with Kite A, August 22, 1908 .

Summary of Observations

Kite A flying line Altitude Pull Wind kind place Obs Angle Obs lbs Obs miles Exp. 22 cord 200+ 10 108° 10 230 1 15.50 Exp. 23 cord 175+ 10 141° 10 325 1 15.12 Exp. 24 rope 150+ 10 89° 10 305 1 16.60 Exp. 25 rope 125+ 10 179° 10 515 1 15.85 Exp. 26 rope 100+ 10 229° 10 470 1 15.55 Exp. 27 rope 75+ 10 350° 10 770 1 15.95 Exp. 28 rope 50+ 10 437° 10 1170 1 14.55 Exp. 29 rope 50+ 10 445° 10 1225 1 14.85 Exp. 30 rope 75+ 10 344° 10 835 1 17.15 Exp. 31 rope 100+ 10 229° 10 565 1 16.80 Exp. 32 rope 125+ 10 172° 10 510 1 17.20 Exp. 33 rope 150+ 10 89° 10 365 1 15.30 Exp. 34 cord 175+ 10 125° 10 425 1 20.04 Exp. 35 cord 200+ 10 127° 10 320 1 16.10 Exp. 36 cord 200+ 10 97° 10 385 1 18.80 Exp. 37 cord 175+ 10 116° 10 330 1 16.10 Exp. 38 rope 150+ 10 96° 10 365 1 17.15 Exp. 39 rope 125+ 10 193° 10 560 1 16.75 Exp. 40 rope 100+ 10 240° 10 675 1 17.25 Exp. 41 rope 75+ 10 350° 10 975 1 19.65 Exp. 42 rope 50+ 10 413° 10 1555 1 17.60

Note:— Experiment 24 was tried at first with a flying-line of stout cord which broke after the 8 y t h observation. A fresh series of observations was then made with a flying-line of Manilla rope, the results being noted in the above table as experiment 24.

The incomplete series of observations with stout cord attached at 150+ before the kite broke away, yield the following results:— Altitude 8 Obs 154°; pull 8 Obs 310 lbs; wind 1 Obs 15.78 miles. During experiments 22–42 the wind was steady and the kite very steady in the air (W.F.B).

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Bedwin's Experiments with Kite C, August 22, 1908 .

Summary of Observations

Kite C flying line Altitude Pull Wind kind place Obs Angle Obs lbs Obs miles Exp. 43 cord 200+ 10 102° 10 345 1 17.80 Exp. 44 cord 200+ 10 102° 10 480 1 17.79 Exp. 45 cord 175+ 10 129° 10 345 1 16.75 Exp. 46 cord 175+ 10 131° 10 420 1 16.55 Exp. 47 rope 150+ 10 90° 10 355 1 17.05 Exp. 48 rope 150+ 10 112° 10 350 1 15.95 Exp. 49 rope 125+ 10 183° 10 490 1 16.30 Exp. 50 rope 125+ 10 202° 10 530 1 19.05 Exp. 51 rope 100+ 10 256° 10 430 1 16.20 Exp. 52 rope 100+ 10 258° 10 530 1 15.85 Exp. 53 rope 75+ 10 343° 10 890 1 16.45 Exp. 54 rope 75+ 10 342° 10 775 1 19.05 Exp. 55 rope 50+ 10 428° 10 1070 1 16.25 Exp. 56 rope 50+ 10 416° 10 1115 1 16.10

Note:— The experiments terminated at 5 P.M. Wind very steady during all observations this series. Kite C was in a badly broken condition from former experiments ridge-pole broken at both ends, and bottom port corner badly smashed at rear. Kite flew very steadily notwithstanding these smashes (W.F.B).

The following tables show the grouped summaries and averages for all of Mr. Bedwin's experiments:—

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Mr. Bedwin's Experiments with Kites D, A, & C, August 22, 1908.

Grouped Summaries .

Kite D flying lines Altitude Pull Wind Kind Place Obs Angle Obs lbs Obs miles Exp. 1, 14, 15 cord 200+ 30 247° 30 638 3 43.45 Exp. 2, 13, 16 cord 175+ 30 338° 30 819 3 48.85 Exp. 3, 12, 17 cord 150+ 30 477° 30 868 3 42.61 Exp. 4, 11, 18 cord 125+ 30 650° 30 980 3 42.10 Exp. 5, 10, 19 cord 100+ 30 858° 30 1110 3 43.11 Exp. 6, 9, 20 rope 75+ 30 888° 30 1285 3 44.90 Exp. 7, 8, 21 rope 50+ 30 1280° 30 1860 3 42.95 Kite A Exp. 22, 35, 36 cord 200+ 30 332° 30 935 3 50.40 Exp. 23, 34, 37 cord 175+ 30 382° 30 1080 3 51.26 Exp. 24, 33, 38 rope 150+ 30 274° 30 1035 3 49.05 Exp. 25, 32, 39 rope 125+ 30 544° 30 1585 3 49.80 Exp. 26, 31, 40 rope 100+ 30 698° 30 1710 3 49.60 Exp. 27, 30, 41 rope 75+ 30 1044° 30 2580 3 52.75 Exp. 28, 29, 42 rope 50+ 30 1295° 30 3950 3 47.00 Kite C Exp. 43, 44 cord 200+ 20 204° 20 825 2 35.59 Exp. 45, 46 cord 175+ 20 260° 20 765 2 33.30 Exp. 47, 48 rope 150+ 20 202° 20 705 2 33.00 Exp. 49, 50 rope 125+ 20 385° 20 1020

2 35.35 Exp. 51, 52 rope 100+ 20 514° 20 962 2 32.05 Exp. 53, 54 rope 75+ 20 685° 20 1465 2 35.50 Exp. 55, 56 rope 50+ 20 844° 20 2185 2 32.35

The averages for these summaries are given on the next page.

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Mr. Bedwin's Experiments with Kites D, A, & C, August 22, 1908.

General Averages .

Kite D flying line Altitude Pull Wind kind Place Exp. 1, 14, 15 cord 200+ 8°.2 21.3 lbs 14.5 miles Exp. 2, 13, 16 cord 175+ 11°.3 27.3 lbs 16.3 miles Exp. 3, 12, 17 cord 150+ 15°.9 28.9 lbs 14.2 miles Exp. 4, 11, 18 cord 125+ 21°.7 32.7 lbs 14.0 miles Exp. 5, 10, 19 cord 100+ 28°.6 37.0 lbs 14.4 miles Exp. 6, 9, 20 rope 75+ 29°.6 42.8 lbs 15.0 miles Exp. 7, 8, 21 rope 50+ 42°.7 62.0 lbs 14.3 miles Kite A Exp. 22, 35, 36 cord 200+ 11°.1 31.2 lbs 16.8 miles Exp. 23, 34, 37 cord 175+ 12°.7 36.0 lbs 17.1 miles Exp. 24, 33, 38 rope 150+ 9°.1 34.5 lbs 16.3 miles Exp. 25, 32, 39 rope 125+ 18°.1 52.8 lbs 16.6 miles Exp. 26, 31, 40 rope 100+ 23°.3 57.0 lbs 16.5 miles Exp. 27, 30, 41 rope 75+ 34°.8 86.0 lbs 17.6 miles Exp. 28, 29, 42 rope 50+ 43°.2 131.7 lbs 15.7 miles Kite C Exp. 43, 44 cord 200+ 10°.2 41.2 lbs 17.8 miles Exp. 45, 46 cord 175+ 13°.0 38.2 lbs 16.6 miles Exp. 47, 48 rope 150+ 10°.1 35.2 lbs 16.5 miles Exp. 49, 50 rope 125+ 19°.2 51.0 lbs 17.7 miles Exp. 51, 52 rope 100+ 25°.7 48.0 lbs 16.0 miles Exp. 53, 54 rope 75+ 34°.2 73.2 lbs 17.7 miles Exp. 55, 56 rope 50+ 42°.2 109.2 lbs 16.2 miles

The above results are shown in graphical form in the diagrams on page 29, and on page 30 are given the calculated lifts, drifts and efficiencies.

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Altidude

Pull

Efficiency

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Bedwin's Experiments with Kites D, A & C, Aug. 22, 1908

flying line lift drift Efficiency Kite D cord 200+ 21.220 21.087 1.006 cord 175+ 23.525 26.781 0.878 cord 150+ 26.093 27.802 0.939 cord 125+ 30.273 30.378 0.996 cord 100+ 35.897 32.486 1.105 rope 75+ 47.385 37.236 1.272 rope 50+ 68.278 45.570 1.498 Kite A cord 200+ 27.861 30.607 0.910 cord 175+ 29.759 35.136 0.847 rope 150+ 35.358 34.052 1.038 rope 125+ 46.328 50.213 0.923 rope 100+ 52.479 52.326 1.003 rope 75+ 79.013 70.606 1.119 rope 50+ 120.122 96.009 1.251 Kite C cord 200+ 28.028 40.541 0.691 cord 175+ 29.331 37.207 0.788 rope 150+ 34.964 34.672 1.008 rope 125+ 45.583 48.144 0.947 rope 100+ 49.636 43.248 1.148 rope 75+ 69.942 60.536 1.155 rope 50+ 102.186 80.917 1.263 31

Our buildings have for a long time past been filled up with old models of large size that have been preserved from sentimental reasons. Now that we are assembling the materials for aerodrome No.5, it becomes absolutely necessary to make room for the aerodrome and for large models of it and for new kites upon the Oionos plan to be used as studies for aerodrome No.6. It became necessary to clear our buildings by either taking the old structures to pieces, or by erecting a new building specially for them. The following structures were condemned and have already been dismembered:— The remains of the old Siamese Twin Kite, The Frost-King Kite, the Selfridge Kite, Kites A, B, C & D and some other unnamed structures of large size.

As Kites A, B, C & D have been specially employed to determine the form of structure for the tetrahedral aerodrome No.5, and are no longer in existence, it may be well to collate here all references concerning them contained in the Bulletins of the A.E.A. and to give some comparative details.

Kite weight winged cells silk Surface Ratio of weight to Surface A 9267 gms 408 cells 22.0830 m2 420 gms per m2 B 8576 gms 253 cells 13.6936 m2 626 gms per m2 C 8766 gms 340 cells 18.4025 m2 476 gms per m2 D 7603 gms 306 cells 16.5822 m2 459 gms per m2 32

References to Kites A, B, C, & D in the Bulletins of the A.E.A.

Kite A .

General notes, including description of kite, weight, surface, flying-weight etc. I, 30; IV, 3, 5, 6; V, 27; VII, 9; VIII, 1, 22, 23, 31.

Photograph:—I, 34; Graphical diagrams VIII, 29.

Experiments:—III, 22, 23; IV, 6, 9, 10, 15, 16, 17, 19, 28, 30; VII, 27; VIII, 1, 6, 7, 9, 16, 25.

Discussion of experiments including statements of summaries and averages:— IV, 11, 12, 13, 23, 32–40; VIII, 13, 14, 15, 17, 27, 28, 29, 30,

Kites B .

General Notes, including description of kite, weight, surface, flying-weight etc. I, 30,31; IV, 3, 5, 6; V, 27; VIII, 31.

Photograph:— I, 35;

Experiments III, 22, 23; IV, 7, 10, 17, 18, 19, 21;

D si iscussion of experiments including statements of summaries and averages:— IV, 11, 12, 13, 22, 23, 24, 33–40.

Kite C .

General Notes, including description of kite, weight, surface, flying-weight etc. I, 30, 31; IV, 3, 5, 6; V, 27; VII, 9. VIII, 27, 28, 29, 30, 31.

Photograph. I, 36. Graphical diagrams VIII, 29.

Experiments. III, 22, 23; IV, 8, 9, 27, 29, 30; V, 27; VII, 23; VIII, 26.

Discussion of experiments; including statements of summaries and averages

Kite D.

Miscellaneous References.

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BULLETINS OF THE Aerial Experiment Association

Bulletin No. IX Issued MONDAY, SEPT. 7, 1908

ASSOCIATION'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN NO. IX ISSUED MONDAY SEPTEMBER 7, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

TABLE OF CONTENTS .

4. Miscellaneous Communications:—

(For illustrations see over).

Illustrations .

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THE REMOVAL OF HEADQUARTERS TO BEINN BHREAGH.

Letters and telegrams from Hammondsport indicate that aerodrome No. 4, McCurdy's Silver-Dart is now practically completed, and that the machine may take the air any day.

It is understood by all the members that the Associations headquarters will be removed to Beinn Bhreagh, Near Baddeck, Nova Scotia, after sufficient time has elapsed to afford Mr. McCurdy full opportunity of testing out his machine at Hammondsport.

A meeting of the Association must be held at Beinn Bhreagh on the 30th of September, to decide upon the future of the Association, as this is the day when the Association, in accordance with its agreement of organization, expires by time limitation, unless some other arrangement is unanimously agreed upon by the members. It is therefore urged that the Hammondsport members should come to Beinn Bhreagh as soon as practicable.

Lieut. Selfridge, our Secretary, has for some time past been in Washington, D.C., having been ordered there by the War Department. It is hoped that he too may be able to visit Beinn Bhreagh before the 30th of September for the continuance of the Association after that date, in its present, or in any modified form, requires the unanimous approval of the members. Should Lieut. Selfridge find that his presence at Beinn Bhreagh upon that date would be inconsistent with his military duties in Washington, D.C., he is specially requested to communicate his views concerning the future of the Association by letter to the Chairman, so that his vote may be recorded. In such an event he is also requested to turn over the records of the 2 Secretary's Office to Mr. Curtiss, Director of Experiments, to be brought to Beinn Bhreagh in time for the meeting September 30.

The ? T reasurer, Mr. McCurdy, is requested to prepare a full report of the expenses of the Association since its formation; and all debts and liabilities of the Association should be paid off before September 30.

Mr. Curtiss, as Director of Experiments, should report at the meeting on September 30 upon the experimental work of the Association from its organization for preservation in our records.

The following business will come before the Association at its meeting on September 30, and it may be well therefore for all the members to be prepared with a definite answer to the queries proposed.

1. The first business will be the appointment of a Trustee to hold the property of the Association under an agreement to distribute the same in accordance with our article of organization.

2. Shall the Association be continued beyond the 30th of September, 1908.

3. Shall the present organization be continued, and if so for how a long a period.

4. Shall the Association be continued in a modified form, and if so what modifications shall be adopted.

Reports.

1. Report of the Chairman.

2. Report of the Secretary.

3. Report of the Treasurer.

4. Report of the Director of Experiments.

5. Report of the Auditor.

A.G.B.

WORK OF THE AERIAL EXPERIMENT ASSOCIATION AS RECORDED IN TELEGRAMS FROM MEMBERS.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 28, 1908: —Made two flights last evening; one with top surface off tail, another with both surfaces off. No noticeable difference with one surface off, but with both off machine was speedy and tremendously sensitive. Will need practice to attain skill. Used new propeller push 212 lbs. Silver-Dart about ready. Will prepare full details before trial

J.A.D. McCurdy.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 28, 1908: — John and I both flew tonight with nothing behind but rudder. No tail.

G. H. Curtiss.

To J.A.D. McCurdy, Hammondsport, N.Y.

Baddeck, N.S., Aug. 29, 1908: — Baldwin's “Little Devil” made twenty-four kilometers per hour this morning without any hydroplanes, an unprecedented feat for a motor boat driven by an aerial propeller.

Graham Bell.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 30, 1908: — John came back last night with June Bug. Drawing wanted mailed to-morrow.

G. H. Curtiss.

To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 31, 1908 :—Glenn made circle to-night. Time 2 minutes and 28 seconds.

J.A.D. McCurdy.

To G. H. Curtiss, Hammondsport, N.Y.,

Baddeck, N.S., Sept. 3, 1908 :—Not advisable I think to enter for Scientific American Trophy, Sept. seven under new conditions without some reasonable prospect of success and without competitors, but do as you think best.

Graham Bell.

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WORK OF THE AERIAL EXPERIMENT ASSOCIATION AS RECORDED IN LETTERS AND TELEGRAMS FROM MEMBERS.

(Letters).

To The Aerial Experiment Association, Baddeck, Nova Scotia.

Hammondsport, N.Y., Aug. 19, 1908: — I have read the last two Bulletins with great interest. The scheme of starting a flying machine from and landing on the water has been in my mind for some time. It has many advantages, and I believe can be worked out. Even if a most suitable device for launching and landing on land is secured, a water craft will still be indispensable for war purposes and if the exhibition field is to be considered, would, I believe, present greater possibilities in this line than a machine which works on land.

An arrangement of floats to support the flyer when at rest would be necessary. Then small hydroplanes to carry it up out of the water and to catch the shock of landing. I do not think the problem is difficult.

For work on land, I would submit the enclosed sketch of a new launching device. Then one fixed wheel is used entirely for starting and alighting, the skids only acting as supports while standing. Balancing on the one wheel can be easily secured with the moveable wing tips and the front horizontal rudder as when flying in the air. If we have the opportunity would you advise trying this on the June Bug?

G. H. Curtiss.

5 6 7

2 To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 26, 1908 :— McCurdy's No. 4 is being assembled and is a beauty. Ingraham, who by the way is doing finely of late, thinks that a couple of days more will see it assembled.

Before taking the June Bug out of the tent to make room for the No. 4 were decided to replace the ribs which had straightened out by getting wet, and which accounts for Selfridge's failure to fly. This has been done and we will fly it to-day with the new surfaces which have no reverse curve. We have also added better lubrication for the engine which will enable us to make longer flights.

The new propeller is a grand success. It pulls ten to fifteen pounds more at 1000 than the old one at 1200 (roughly). I mailed yesterday a print of the folding tail on the June Bug which is Ingraham's idea. We can now make quick work of getting the machine out of flight.

Some stories have been going the rounds of the newspapers referring to a New York man, whose name is not mentioned, having ordered a flying machine for the Curtiss Manufacturing Company. For the most part there is no truth in it. It originated from a conversation with Mr. Baldwin in which he jokingly said he wanted one. As you know, most newspaper articles are unreliable.

Mr. Dienstbach of New York is with us. He is spending a couple of weeks in Hammondsport writing up aeronautical stories

G.H. Curtiss.

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3 To Mrs. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 26,1908: — You must be anxious to know what we are doing here. We are busy enough but things go rather slowly. We have one consolation, however, and that is that the No. 4 machine is being built, as you might say, “like a watch” and looks like business throughout. The parts are well finished, the results of knowing what we want and not having to change as in the previo i u s machines.

We learned that Selfridge's lack of success in flying the June Bug was due principally to the surfaces straightening out and losing their curve which gives them the lifting effect. We have made new ribs and are putting them in so that further experiments can be made with the machine before it is taken out to make room for the No. 4.

G. H. Curtiss.

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To Dr. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 29, 1908 :— We enclose prints of the old June Bug as it now appears. As we wired you last night, John and I both flew it with the tail entirely removed. The print shows the way we fastened the rudder.

The object of this experiment was to gain knowledge for the No. 4. We now believe that with larger front surface placed further forward the tail is entirely unnecessary; more speed is obtained and the turn seems to be easier although we cannot quite account for this. Per haps the vertical surface of the struts on the tail were enough to retard the turning action.

You have probab y l y seen the photos and description of the Wrights'. They do not seem to have anything startling, but I cannot say as much about Mr. Herring; I believe he employs gyroscope, and I think there are great possibilities in this line. I see no other solution of automatic stability.

G. H. Curtiss.

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To Mrs. A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Aug. 30, 1908 :— You ask me in your letter why we thought of the “Silver-Dart” as a name for aerodrome No.4. Well the surfaces are silvered on one side, that suggested the “Silver”, and the word “Dart” will explain itself. Also the combination of the two words sounded rather attractive to me. You didn't criticise but we understood Mr. Bell's telegram to mean that the name was quite agreeable to you all.

She certainly is a beauty. At present the four wings are assembled and all the wiring done. The truck with three wheels attached i ? s all ready to secure in place to-morrow. We think that we ought to use a double-decked front control. It gives greater scope for rigidity, and also has double the surface for probably the same head resistance.

Another point is, that the front control ought to be powerful enough to CONTROL the machine under any condition whether simply gliding at a reduced speed, or under full power from the motor. When we get flying in heavier winds, we may want to force the machine to depress or elevate, and that might require quite a turning force.

We have been having quite interesting flights with the old June Bug the last few days. We were anxious to try her without a tail so first we removed the top surface of the double decked tail and upon trying a flight no change in stability manifested itself.

We then removed the bottom surface (both removed now) and tried a flight under “bare poles” as it were. The difference in stability was very marked. The machine would answer 11 the control so much more readily and quickly that the least possible movement in changing the angle of incidence of the control was necessary to preserve a flight in one horizontal plane.

Day before yesterday we removed the tail structure altogether, and simply built out a support for the rudder as follows:— (diagram). The center of the rudder comes just opposite, or in continuation of the propeller shaft.

We tried this day before yesterday afternoon Friday and found that the instability had disappeared and she could be handled with perfect ease.

This may have been due to several causes, more skill in management, or lack of drag of the tail structure.

The old ribs have all been removed, and ribs such as we are to use on the Silver-Dart substituted. These ribs have just the single curve and are made of four plies instead of three to obtain greater strength. Now upon trying the machine night before last (Friday) under these conditions new ribs of single curvature, and without a tail, (the man moving back seven inches to make up for load removed from rear by removing the tail) I found that the machine would glide!

Approaching the place I wanted to land on I shut off the motor as in former cases and expected to land just as, I had planned but the machine kept on gliding for a distance of 12 200 feet and I was about 15 feet in the air when I shut off. Of course manipulated the control to keep her on an even keel fore and aft. Mr. Curtiss tried a short flight next, and he went through the same thing although from the knowledge gained from the flight he shut the motor off and allowed for a glide of about 200 feet. She lands beautifully and without any jar whatsoever.

Last evening (Saturday) we went up to the track about five o'clock and I attempted a flight. Everything worked beautifully and much to the pleasure of everybody I was enabled to describe the figure eight after covering a distance of two miles. Upon coming down the home stretch I intended to land on the track, but the engine sounded O.K. and the people excited etc. were standing to my right so I thought I might as well attempt another turn. I could see the people with their mouths going although I couldn't hear anything like a noise.

The machine is speedier than before and we are using another propeller which allows the engine to turn over slower 13 and yet produce more push.

Here is a comparison of the two propellers. A is the one we have always used in the June Bug, and B is the new one.

A diameter 5 ½ feet; pitch 4.2 feet.

B diameter 6 feet; pitch 4 feet.

Pull revolutions per minute Miles per hour (theoretical) A 200 1266 65 200 1266 65 B 215 1104 50.2 210 1062 49.0

These tests were made with the engine in a sling in a large closed room. Readings taken one right after another. It seems to show that what we want is greater diameter and smaller pitch.

Please ask Mr. Bell if we are to enter for the Scientific American Tr p o phy game on Septem ber 7. We may not have the new engine ready, but yet there is a chance.

J.A.D. McCurdy.

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WORK OF BEINN BHREAGH LABORATORY by Wm. F. Bedwin, Superintendent.

Have received from Montreal 150 yards of nainsook which is available for work at any time. We have also received from Hammondsport s upply of sprocket wheels and chains to be used with the double propellers on Aerodromes 5 and 6.

Tetrahedral Aerodromes NO. 5 .

We have made two models of the No. 5 aerodrome for study purposes, one a half sized, and the other a quarter sized model. These are of hollow type constructed like Kite D. We have also made another model of full construction as in the Cygnet (or Kite A) for comparison purposes. The half sized models have 32 cells on the ridge-pole, and are 8 cells high. We are now at work making some changes in the beading.

We have finished the assembling of sectional,2 and 3 of aerodrome No. 5, and they have been lashed together. Each section is lightly beaded on the outer edges alone, and the heavy beading will not be put on until the whole structure has been assembled. We are now at work putting together sections 7,8,9 etc. (See illustration showing the plan of sectional construction used in aerodrome No. 5).

Tetrahedral Aerodrome No. 6 .

A new outrigger-truss and new floats have been made for the Dhonnas Beag. Photographs are appended showing the old and new in comparison. Four sets of iron hydroplanes have been made for attachment to the Dhonnas Beag which are shown in appended

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2 We are getting a set of double propellers, rotating in opposite directions, ready to put on the Dhonnas Beag.

The globular connection devices to be used in the tetrahedral framework to be placed on the Dhonnas Beag are progressing rapidly now. We have ordered fish-shaped sticks for the cells, and expect them here shortly.

Dates of Experiments .

Aug. 19, 1908: — Experiments with Kites A and D and the Pilot Kite; also experiments with the Dhonnas Beag towed in the harbor to ascertain the strain of the towing-line at various speeds.

Aug. 20, 1908 :— Experiments with Kites A and D, the Victor Kite, and the White 50 centimeter celled kite; also experiments with the Dhonnas Beag with weight of engine high up trying stability.

Aug. 21, 1908 :— Experiments with the Frost-King Kite; 84 observations, 4 of wind, 40 of altitude, and 40 of pull. Experiments in the afternoon with Kites A and D with a bag of sand attached to Kite D to make it of the same weight as the o bb th er.

Aug. 22, 1908 :— Kite flying all day with Kites A,C, and D. 1176 observations. Wind, 56, altitude, 560, pull 560 observations

Aug. 25, 1908 :— Experiments with the Dhonnas Beag with engine on and propeller by her own propeller.

Aug. 26, 1908 :—Experiments with the Dhonnas Beag with engine on and propelled by her own propeller.

Aug. 29, 1908 :— Experiments with the Dhonnas Beag with engine on and propelled with her own propeller. Attained speed of 15 miles an hour. W F B.

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PLANS FOR AERODROME NO. 5 by A. G. Bell.

In considering the whole subject of tetrahedral construction there are two points that constantly recur as unique and advantageous.

1. That we possess the ability to build large structures of indefinite size without increasing the ratio of weight to surface.

2. That large aggregations of winged cells, without any horizontal surfaces at all, exhibit marked stability in the air; the structures containing the largest numbers of cells seeming to be the most stable.

No one, I think, who has seen a large tetrahedral structure flown as a kite in a fully supporting breeze can help feeling what a great thing it would be if such a stable structure could be made the basis for an aerodrome, and propelled through the air by its own motive power.

The moment we begin to prepare for practical experiments looking towards this end certain disadvantageous conditions present themselves.

The winged cells are markedly inferior in supporting power to the same surfaces arranged horizontally, so that a structure designed to support a man and an engine in the air would have to be built of much larger size than in aerodromes of the June Bug class. This difficulty however is easily overcome on account of the ability to increase the dimensions of the structure without increasing the ratio of weight to surface. There is not therefore the same objection to a large structure as in the case of one in which the weight would increase as the cube of the dimensions, while the surfaces increase only as the squares.

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2 If it is desirable to support a man and an engine in the air in a tetrahedral structure to be flown as a kite, it can certainly be don ? e by increasing the size of the structure to a sufficient extent. But here fresh difficulties appear from the aerodrome point of view in the form of increased head resistance due to the increase of size, demanding apparently an engine of greater power than in the June Bug class of aerodrome. But greater power involves greater weight in the engine; and greater weight in the engine involves a still larger structure to support it etc. e ct tc . etc., so that we really do not know how far it may be practicable to propel such a structure by the engines we possess. Of course the proper way to ascertain this is by experiment.

What we do know from our former experiments is this, that we can certainly build a tetrahedral structure that will support a man and an engine in the air when flown as a kite. We have already supported a man; and are entitled to conclude that without any change in the arrangement of the cells, a still larger structure than the Cygnet would also support an engine. It is not necessary for support that the engine should be in operation at all: We can certainly sustain it through the action of wind.

We have then the opportunity of ascertaining just what an engine and propeller will do with such a structure without any danger of the structure coming down through the failure of the engine to give sufficient power for self support.

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3 Should the engine happily prove sufficient for this purpose the tow-line will become slack. It can then be dropped and the machine proceed on its way as a free flying machine

If, on the other hand, the engine power should prove insufficient the machine will not come down but will continue flying as a kite. The engine and propeller will certainly produce some effect which we can study and measure. The strain on the flying line for example will certainly be reduced; we can observe this reduction of pull instrumentally, and thus be able to accumulate data from which to calculate the amount of power required for self support; and the general practicability of a tetrahedral aerodrome of this kind which makes no use of horizontal surfaces. Through the presence of a man in the structure, we can also obtain data concerning the angle of incidence of the supporting surfaces to the wind, a matter of which we are ignorant at the present time.

In aerodromes of the June Bug class, if the engine power is insufficient, the aerodrome will not fly at all; and it is only when sufficient power has been obtained for support that experiments can be made in the air. There is no half way between these conditions, but in a kite aerodrome we have intermediate conditions all the way from the kite without self propulsive power at all up to the free flying machine without a restraining rope. I look upon the kite as a flying machine at anchor, and the flying machine as a free kite; and between these two conditions we have a vast field for exploration with engines and propellers operating under the actual conditions of flight, the whole being supported in the air by the wind 22 4 whether the engine should prove self supporting or not.

Aerodrome No. 5

The attempts to produce a tetrahedral aerodrome at Beinn Bhreagh were commenced last year, and were carried to the point of raising a man into the air in the kite Cygnet. (See photographs of plans of the Cygnet appended to this article).

The stability exhibited by the Cygnet when carrying Lieut. Selfridge was in every way satisfactory, but the experiment lasted for so short a time that the instrumental data secured were quite inadequate to afford a safe basis for calculation.

The mode of descent of the Cygnet too was in every way satisfactory. It came down so gently that Lieut. Selfridge was unaware of the fact that he was descending until the structure actually reached the water. This indeed, was the cause of the subsequent disaster. The initiative in le th e matter of letting go the towing-line had been left to Lieut. Selfridge. It had been arranged that when he was ready to come down, he should make a signal to the steamer Blue Hill. The steamer was then to reduce speed, and the men on the Blue Hill were to be prepared to let the towing-line gradually slip from the cleat as the kite neared the water, and at the moment of actual contact with the water the line was to be let go at both ends, Leut. Selfridge releasing it from the kite and the men at the other end releasing it from the Blue Hill.

147554-T

CYGNET Scale — 1cm. 25 cm. Front Elevation Top View Bottom View

Side Elevation 3393 cells Surface (including bow) — 1840000 cms. 2 Weight (including floats) — 100334 gms. Ratio — 545 gms per m. 2 (oblique)

Beading Details

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An unfortunate combination of circumstances prevented the release of the towing-line at either end, while the Steamer Blue Hill did not reduce its speed. The smoke of the Blue Hill so obscured the view of the observers on the steamer that they as well as Lieut. Selfridge were unaware that the kite was coming down until it was down. The towing-line at the Blue Hill end of the line was lashed to a dynamometer attached to the cleat in such a manner that the line could not be released at a moments notice. If I remember rightly a man had been stationed there with an axe to cut the line in the event of an emergency, but the observers were so little prepared for the descent of the kite that even this was not done until too late. As Robert Burns observes:—

“The best laid plans of mice — and men — gang aft aglee”.

No signal having been made, the Blue Hill did not stop or reduce speed; the attachm ?? en t of the dynamometer to the cleat prevented the gradual release of the tow-line when it was realized that the kite was coming down; and the unpreparedness of the man with the axe prevented the sudden release of the line by cutting until too late.

At the other end of the line Lieut. Selfridge being so far in the interior of the kite that he could not see the water on account of the silk surfaces below him, and being quite unaware from sensation alone that the kite was dropping on account of the gentle descent, failed to make any signal to the Blue Hill, or to change his center of gravity to cause the kite to go up again (as he had done at the beginning of 27 6 the experiment, when there was danger of the kite touching the water). He was so little prepared for the descent that he allowed the kite to come right down on the water without releasing his end of the tow-line.

All these circumstances combined contributed to the sudden destruction of the kite. It was towed at full speed through the water by the steamer Blue Hi ? l l; and as, of course, the structure was not designed to stand such a strain, it naturally broke in pieces.

So far as the experience in the air was concerned the behavior of the structure was most encouraging and satisfactory; and it is only to be regreted that we did not have sufficient time before the final disaster to accummulate instrumental data that would guide us in subsequent experiments.

We cannot therefore stop our experiments in this direction with the construction of the Cygnet; but must go on and build another machine on the same general model large enough to support both a man and an engine in the air when towed by a steamboat against a good wind, and then accumulate sufficient data concerning the conditions of light to yield reasonably reliable averages which may be made the basis of calculation.

While the ratio of weight to surface is substantially the same in a large tetrahedral structure, as in a smaller one on the same model, it by no means necessarily follows that the surfaces are all equally efficient; In the large structure of o f ull tetrahedral construction the interior cells are much more 28 7 shielded by those in front of them, than in the case of the smaller model. Indeed it was a great surprise to find that the mass of closely packed cells known as the “Frost-King” would fly at all; and it was a still greater surprise to find that it would support a man hanging on to the flying line. The still larger aggregation of cells employed in the Cygnet flew with such increased lifting-power as to support a man easily in the air in the midst of the structure. In fact we have found that each increase in size has given us greater lifting-power; so that it is obvious that whatever shielding action is exerted upon the interior cells, the adavantages of the combination as a whole have outweighed the disadvantages, at least so far as lifting-power is concerned. It is also obvious that the limit of size, if there is a limit, has not yet been reached, and we can confidently increase the dimensions of a structure like the Cygnet with reasonable prospect of getting it to fly when towed by a steamer against the wind.

One of the reasons that led to the adoption of the full form of construction in the Cygnet arose from a feeling that the interior cells, even though they might not be as efficient for support as the exterior cells, gave greater streng? to the structure as a whole. The hollow type of construction seemed to me to lack strength in the very place where it should be strongest — the middle.

I was therefore much surprised when Mr. F. W. Baldwin stated that, from an engin n e ers point of view, the interior cells were of little consequence to the strength of the combination; and that the outer part of the structure was of so 29 8 much more consequence that the whole of the interior could be scooped out without injuring the strength of the combination as a whole by taking the material from the inside, and placing it upon the outside in the form of stronger beading, or strengthening material. He pointed out the fact, very obvious when stated, that a pipe may be very strong indeed without any interior material at all.

In attempting to build a large structure of the Cygnet form, it has become obvious that the interior cells can, if desired, be omitted without danger of diminishing the strength of the structure. No necessity exists for the retention of these cells unless it can be shown that their presence materially assists in the support of the kite.

Before deciding upon the actual type of structure to be adopted in the new machine, it was thought advisable to test the efficiency of interior cells by constructing kites of both full and hollow construction of sufficient size to develop the point.

Such kites were made in Hammondsport, but there were very few occasions upon which they could be tried, and the observations made with them were inadequate in number and reliability, to yi l e ld positive results. Upon the principle therefore of adopting the known and proved form of construction in the large structure, it was decided that the full construction would be used in the new aerodrome unless reliable data could be obtained at Beinn Bhreagh indicating that the hollow type of construction would be equally efficient ?? fo r 30 support.

Kites A,B,C & D were therefore made at Beinn Bhreagh, and we were fortunately favored with a few days when the wind conditions were exceptionally good. A large number of comparative observations have been made of these kites in the air flown separately and together. The observations have been so numerous as to yield averages that may fairly be considered as reliable.

As the general result of these observations it was found that the full type of construction exemplified by kite A possessed no points of superiority over the hollow type exemplified by D, with the doubtful exception of a sort of “water-logged” stability due probably to the presence of inefficient cells. It was certainly demonstrated that Kite A was a heav ei ie r-flying kite than Kite D, and required a greater wind to support it. The smaller aggregate of cells employed in the hollow Kite D proved quite as efficient for support as the larger aggregate of cells massed in Kite A.

Kite D too possessed many points of advantage over A from a structural point of view, especially when it was proposed to adopt it in a structure of the size we are building. One great point lies in the ability to build the large structure in sections of small diameter so that every part of the structure can be easily reached both during the process of construction and the process of repair.

The materials for the new aerodrome are being rapidly assembled. Figs. 1 & 2 will give a general idea of the nature of the structure. It will contain 64 cells in the top layer, 31

Plans for Aerodrome N o. 5 Side View Fig 1 Face View Fig 2 AGB

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Plans for Aerodrome N o. 5 End View Face View End view Arrangement of Sections Fig 3 AGB

33 49 cells at the bottom, and will be 16 cells high. Thus the aerodrome will be 16 meters from side to side on the top, 12 meters from side to side on the bottom, 4 meters high (measured obliquely), and four meters deep from fore to aft at the bottom. This of course gives the dimensions only of the main part of the structure and does not include the protruding beak for the support of the front control. It is not proposed to use any tail, as the rear cells of the structure are believed to act as a tail. The exact position and form of the vertical rudders, or adjustable wing tips, if such are considered necessary, have not yet been decided upon.

The cellular part of the structure is being built in 16 sections, which are illustrated in Fig.3. The 16th section will contain the body with its protruding beak, details of which will be furnished later. The other sections are all triangular in cross-section (1 meter on the side), and contain a hollow space in the center forming in cross-section an equilateral triangle having a side of 50 centimeters. Each section is being beaded with very light material on the outside edges only. These sections will then be lashed together; and when the whole cellular part of the structure has been assembled through- beading will be added of stouter material to give strength and solidity to the whole.

Sections, 1,2, and 3 have already been completed and have been lashed together. The other sections are being so rapidly assembled that it is probable that the whole cellular part of structure will be ready for the through-beading before this Bulletin is issued. A G B.

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BALDWIN'S EXPERIMENTS WITH THE DHONNAS BEAG AUG. 25, 26, 29, 1908, WITH A FEW NOTES OF PROGRESS: by A.G. Bell.

Aug. 25, 1908 :— The Dhonnas Beag was tried this afternoon with Mr. Baldwin on board. It was propelled by the Curtiss motor No. 2 with aerial propeller, 140 cm diameter. The propeller had originally been 150 cm diameter with 17° ½ at tip, but had been cut down to 140 cm diameter and the ends rounded and shod with brass. Dr. Cobb estimated that the boat traversed the 100 meter course with the wind in 24 seconds; and against wind in 30 seconds. The push of the propeller was found to be 45 lbs., instead of 85 lbs. as in former experiments.

Aug. 26, 1908 :— Mr. F.W. Baldwin reports concerning his experiments with the Dhonnas Beag to-day as follows:—

Exp. 1. Tried Dhonnas Beag this afternoon (Aug.26) first taking thrust of propeller. New carbureter was fitted and engine ran nicely giving thrust of about 85 lbs. On first trial boat speeded up quickly, and just as she had attained about her full speed the starboard out-rigger float tore itself loose from the out-rigger. This threw the boat around quickly to port. I shut off immediately, and by meeting her with the helm and leaning well out kept the boat from upsetting.

A quick turn has a strong tendency to depress the outside float due to the inertia of the engine.

Exp. 2. The floats were then more securely fastened and a second attempt made. This time at full speed the port float seemed to bury itself, and fearing the consequences I had to shut off again before the 100 meter course had been completed.

Exp. 3. Both floats were raised a little at the bow to secure them against diving, and on the third trial we got the time up and down over the 100 m course. On the way down the harbor the boat was not quite under full headway and took 20 # seconds. Coming back she was well under way, and opened out full with spark advanced and covered the 100 meters in 35 2 18 seconds. There was practically no wind at the time, but what there was was against her going down the harbor and with her coming back. F.W.B.

Aug. 29, 1908 :— Mr. Wm. F. Bedwin makes the following report concerning Baldwin's experiments with the Dhonnas Beag to-day:—

Exp. 1. This morning (Aug.29) in going down the harbor the Dhonnas Beag made 100 meters in 17.5 seconds engine worked fine.

Exp. 2. Going down harbor made 100 meters in 21 seconds. Coming back made 100 meters in 27 seconds; engine not working well.

Exp. 3. In flat calm the Dhonnas Beag made 100 meters in 15 seconds going down the harbor and made the same speed coming back (100 m in 15 seconds).

Exp. 4. This afternoon (Aug.29) the Dhonnas Beag going down harbor made 100 meters in 18 # seconds, engine not working well.

Exp. 5. Down harbor 100 meters in 20 seconds engine not working well.

Exp. 6. Down harbor 100 meters in 15 seconds; up harbor 100 meters in 16 seconds; pretty good breeze.

Exp. 7. Down harbor 100 meters in 14 seconds up harbor 100 meters in 17 seconds, pretty good breeze. Wm. F.B.

Early in the afternoon before the 4th experiment was made the Gauldrie came into Beinn Bhreagh Harbor with a number of visitors to see what we were doing. On board were Dr. and Mrs. Thayer, of Baltimore, Md., Dr. Cobb of Washington, D.C., Mrs. A. G. Bell, Mrs. F. W. Baldwin, Miss Cadel, Miss Gertrude Grosvenor, Mr. Byrnes, and Capt. McIver. Other witnesses of the experiment not on board were Mr. Angus McInnis, Mr. John McDermid, and the Laboratory staff employed upon the experiment. The Gauldrie remained in the harbor while experiments 4 and 5 were being made, and then went away leaving as witnesses of 36

The Dhonnas Beag. 106 Taken 1908 Aug 29 D?? 1908 Aug 31

37 3 Experiment 6 and 7, Dr. Cobb, Mr. McInnis, Mr. John McDermid, and the Laboratory staff more immediately concerned in the experiments, including besides myself, Mr. F. W. Baldwin, Mr. Wm. F. Bedwin, Mr. MacDonald (our photographer), another Mr. MacDonald, Mr. MacFarlan and others.

General Remarks .

The speed of the Dhonnas Beag "in a flat calm" (Aug. 29, Exp.3) was about fifteen miles an hour. If any such speed can be obtained when hydroplanes and aeroplanes have been attached to the boat, there can be no doubt that the Dhonnas Beag will rise out of the water into the air, and become a true flying machine.

The very promising results so far attained indicate that the experiments will not only result in a safe means of getting into the air, but will also lead to radical improvements in the methods of propelling steamboats, and motor boats of every kind, over, not through, the water:— Both aviation and navigation will be benefitted.

It is important that, in this new kind of motor boat and this new species of flying machine, the different steps of development should be fully noted, and in consecutive order; but I doubt very much whether this is being done by Mr. Baldwin, who has aerodrome No. 6 specially in charge. In order to supplement his notes therefore, I will here record a few of the changes that have been made in the apparatus, or are under contemplation.

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4 Changes of Apparatus .

1. The outrigger-floats used in experiments Aug. 19, and in the earlier trials were 108 cm long, 10.5 wide, and 21 deep. Each weighed 2 ½ lbs., and had an estimated maximum displacement of about 30 lbs. It was thought that the resistance to upsetting could

be improved, without detriment to speed, by lengthening the floats without materially increasing their width or depth.

New floats were therefore made, which were 183 cm long, 13 wide, and 20 deep. Each weighs 6 lbs., and has a maximum displacement estimated at about 64 lbs. Both the new and the old pairs of floats are shown in a photograph in this Bulletin.

2. The upsetting tendency has been favored by the high position of the center of gravity, resulting from the necessity of placing the engine at a considerable elevation above the boat hull in order to allow the propeller to clear the hull, the propeller being driven directly from the engine-shaft.

It is hoped to diminish this tendency by lowering the position of the engine and using an indirect drive. The engine will be placed as near the hull as practicable and will work the propeller indirectly by a chain and sprocket wheel. The chain and sprocket wheels to be used arrived from Hammondsport Aug. 27.

3. In the earlier experiments with the Dhonnas Beag the outrigger-truss was placed in front of the engine-bed, and Mr. Baldwin used it as a seat.

Thinking, however, that the weak hull might be subjected to twisting strains by swinging motions of the elevated engine, 39 5 he has recently placed the truss directly beneath the engine, and now uses the deck of the boat as a seat where it has been strengthened by a board placed across it, a little in front of the engine-bed. This is also advantageous by bringing his own center of gravity lower down than before.

4. In the experiments Aug. 26 and in the earlier trials the outrigger-truss used terminated at either end in a point, or narrow nose, which rested upon one of the floats at about its thickest part. The float had some liberty of rocking upon the end of the truss as an axis. The longer floats developed a tendency to dive (Aug. 26), and one of them tore loose from its attachment. The truss also did not seem to possess sufficient rigidity against

twisting motions, although it had been strengthened by a zig-zag beading of metallic tubing (aluminum)

To remedy these defects a new outrigger-truss has been made, not terminating in a narrow nose, but of equal dimensions from one end to the other. Like the old truss it is triangular in cross-section. It is much superior in rigidity to the old truss employed and permits of a more rigid connection with the outrigger-floats. It was used in the experiments (Aug. 29).

5. The Dhonnas Beag, when traveling upon a straight course, exhibits a constant tendency to depress its right or starboard float, a result attributed to the torque produced by the left-handed rotation of the propeller.

Mr. Baldwin has hitherto neutralized this tendency by leaning over to the port side; but it is now proposed to do away with torque altogether by employing two propellers rotating in opposite directions upon the same axis. Double propellers

BULLETINS OF THE Aerial Experiment Association

Bulletin No. X Issued MONDAY, Sept. 14 , 1908

ASSOCIATION'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN NO.X ISSUED MONDAY SEPTEMBER 14, 1908.

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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THE COMING OF THE WINGED CYCLE. THE WINNING OF THE FIRST AMERICAN TROPHY FOR A MAN CARRYING FLYING MACHINE: by David Fairchild.

We have seen a man fly through the air like a bird. A feat that centuries have waited for has been done, and we have seen it. A mile in a minute and forty seconds, twenty feet high in the air;

Standing at sunset in the Pleasant Valley where the clover was knee high and with the last rays of the sun lighting up the forest and vine covered hills around, we waited for the breeze to die down so that Curtiss could fly.

On an old race track a hundred yards away was a big thing of yellow cloth stretched on sticks and stayed by wires. Our eyes were riveted on it and in breathless expectation we waited for it to move.

What can compare with these first beginnings of great things! The crowds who lined the Hudson when Fulton first steamed up it have scarcely crumbled to dust; those who listened in expectation for the first spoken word over miles of metal wire are not yet old; and to stand in the gathering dusk of a mountain valley in your own country and wait to see, not only a man but a man whom you have been interested in for years fly over you, is the experience of a lifetime.

Scattered over the field were the reporters of New York dailies with their cameras, the representatives of the Aero Club, the relatives of our friend, and the admiring workmen of his motor cycle factory, while seated on the hillside close by were the hundreds of towns-people who had come to see the hero of their town win the first American trophy for a 2 2 man carrying flying machine.

Mixed with the expectation was an anxiety lest somethin? happen, lest you should be on the point of seeing a tragedy with all that your near association with the man and your admiration for him would mean.

The groups of workmen discussed the previous trials of the aeroplane and expressed their confidence that Glenn Curtiss, the boy who put in electric door-bells in the village and sold the repaired bicycles of the town in his little shop at the corner of the square, would carry off the trophy this time all right.

Suddenly the group of people about the machine scattered into the fields, Curtiss climbed into the seat in front of the yellow wings, the assistant turned over the narrow wooden propeller, there was a sharp loud whirr and a cloud of dust and smoke as the blades of the propeller churned the air 1200 times a minute.

The men holding the gigantic bird let go. It started down the track on its rubber tired wheels going faster and faster. Then, before we realized what it was doing, it glided upward into the air and bore down upon us at the rate of 30 miles an hour. Nearer and nearer it came like a gigantic ochre colored condor carrying its prey. Soon the thin, strong features of the man, his bare outstretched arms with hands on the steering wheel, his legs on the bar in front, riveted our attention. Hemmed in by bars and wires, with a forty horse-power engine exploding behind him leaving a trail of smoke and with a whirling propeller cutting the air 1200 times a minute, he 3 3 sailed with forty feet of outstretched wings twenty feet above our heads.

Thirty miles an hour in an auto seems fast going where fence posts and wayside flowers mark the speed, but in the air with nothing but the distant hills to go by the passage of this giant flying thing seemed leisurely and graceful.

What a moment for the vivid imagination. The thing is done. Man flies! All the tedious details of perfecting a practical passenger carrying machine are forgotten. Even the previous successes of which you have seen reports mean nothing and with one leap the imagination builds on this one positive fact which your eyes are seeing, a whole superstructure of world locomotion. You think of the plovers that hatch their young in the summer of the Arctic Circle, teach them to fly in Labrador and spend the winter with them in the Argentine to return again over Mexico in the Spring. You remember the flights of homing pigeons that cover 500 miles in eleven hours and these suggest strange visions of great fleets of airships crossing and re-crossing both oceans with their thousands of passengers. In short we cast aside every pessimism and give our imaginations free rein as we stood watching the weird bowed outline pass by.

Oh, why does he go so high? Do you think he's going to make it? These cries from Mrs. Curtiss, who was standing by us, reminded us of the dangers of the flight and of the fact that out in the meadow a half mile away there was a red flag which marked the end of the course. Would he pass over it? 4 4 The machine which was twenty feet or more above our heads seemed to slowly descend until it was not more than ten or fifteen feet high, but it did not go lower. Directly over the stake it steered, rising higher as it went, and away it soared over the fences turning to the left and settling gently down in a pasture over a mile away from where it left the race course. Yells and cheers and screams from the groups of spectators announced the fact that the trophy was handsomely won and then, over potato fields, through vineyards and oat fields and down the railroad crowds of men ran to cheer the successful navigator and to bring back to its tent the uninjured “June Bug”.

In one minute and forty seconds Mr. Curtiss had ridden witch fashion astride a motor driven broom stick, as it were, eighty feet more than a mile through the air and used up in the flight less than a quart of gasoline.

One thing was missing, the presence of the great American advocate of heavier-than-air machines, Mr. Alexander Graham Bell, whose success as a pioneer in another field makes his prophecies sought for in this. He is the originator, organizer and financial backer of the Aerial Experiment Association of whose activities this gigantic “June Bug” is the latest production. The Association has been carrying on two sets of experiments, one at Mr. Bell's Nova Scotia laboratories with tetrahedral kites, and the other at Mr. Curtiss' shops in Hammondsport with gliders and horizontally placed aeroplanes. In the “June Bug” the younger members of the Association, Mr. Curtiss, Mr. Baldwin, Lieut: Selfridge and 5 5 Mr. McCurdy, have been given more or less a free hand and they have combined in it as many as possible of the valuable points of previous experimenters adding some of their own and working out the details with great care.

The excitement of the flight being over, we began to ask seriously what the “June Bug” could be counted on to accomplish, and get the clearer perspective of such students of the new art as Herring, Manley, Baldwin and the members of the Aerial Experiment Association. It is an infant now of course and in the still air stage; a gust of wind presents difficulties which have not been mastered. “When I strike a gust of wind its like hitting a steep grade on a motor cycle; its as solid a reality as that”, says Mr. Curtiss.

This weird new craft had made sixteen flights recently with occasionally a wing broken or a mishap to the steering gear, and when we asked Mr. Curtiss as we walked back, pushing the awkward aeroplane before us through the long grass, whether it wasn't nervous work and if he wasn't exhausted, he said, “Its no more nervous than running a motor cycle, and I don't feel any unusual exhaustion, and in still air I don't think there is any more danger, but I don't know enough yet to handle it in a breeze. There is no especial difficulty in landing if I can keep up my headway, and this time I came down on all three wheels as easily as anyone could wish to”.

There are many who have looked on an aeroplane as something which only can acrobat could manage. There is truth in the statement that one must know how, but when it is considered that in fourteen trials Mr. Curtiss mastered the art 6 6 sufficiently to sail a mile without difficulty, all the insuperable difficulties in the way of a pleasure aeroplane have disappeared and one is forced to the conclusion that aeroplaning as a sport, for those who can afford it, is really on the program.

The power for the “June Bug” has been found in an eight cylinder, forty horse-power, air-cooled engine, weighing only 200 pounds, acting on a six foot long by eight inches wide wooden propeller. Two horizontal curved planes 42 feet long by 6 feet wide of spruce lumber braced with wire and covered with strong cotton cloth filled to make it air-tight, a horizontal cloth covered controller in front to steer it up and down, a vertical rudder behind, to steer it from side to side, with the necessary net-work of wire cables, gas pipe and zink sockets to hold the whole together, these make the “June Bug”. Of course, the curves of the surfaces and the cross sections of the framework are according to carefully worked out formulae.

The difficulties of flight have been difficulties arising from our idea that the air is a gas and not a solid. But as Herring expresses it, “If you rotate a plane surface rapidly enough in the air it is held between the upper and lower air masses as rigidly as though you ran it along a crack in a brick wall”. “Hit the air hard enough and it reacts like a solid”, is one of Prof. Langley's statements, I believe, and as you stand behind the propeller of the “June Bug” when it is revolving at 1200 turns to the minute you 7 7 realize the truth of this discovery. The motor boat propeller which revolves 400 times a minute, sending you through the water at a rate of 15 miles an hour, requires a powerful engine but you do not wonder at this. It is an education in physics, however, to find that to turn this narrow 6 foot propeller 1200 times a minute in the air takes a 25 horse-power engine.

The engine of the “June Bug” is a Curtiss motor, the work of a master mind who has risen out of one of the thousand of little bicycle shops which the advent of that strange vehicle created all over the world. The Curtiss bicycle shop is still standing on the Park Square of Hammondsport and its former owner has erected on the hillside among the peach tre?s of his father's place perhaps the most unique set of machine shops in the world for the manufacture of motor cycles and airships motors. The factory buildings, make-shifts of boards, show the rapid developments of this new industry and to-day the airship constructors and operators of the country come to Curtiss for their engines and to test out their ideas. His aerodrome, a shed looking like a deserted ice house, accommodates the debris of all sorts of abandoned airship dreams.

Hammondsport has become, as it were, the Airship Town of the world, and one must visit it to get the airship fever, just as one has to visit a mining camp to get the gold fever. It is in the air, and the children's toys are on wings, their teachers despair of getting them to learn their book lessons when an experiment is in progress.

It may perhaps be unwise to navigate the upper air in our imagination before we have actually much more than gotten 8 8 off the ground, but it is much easier for men to follow the trail than to blaze the way and what has been done by a few men will soon be attempted by thousands.

Before inventors gave the world a bicycle no one could believe that it was possible for a man to balance himself on a revolving wheel. As soon as a single man showed it to be possible thousands followed and the bicycle era came. Independent inventors have now given us the winged motor cycle and have driven it through the air, and we seem to be on the verge of the winged cycle era. Besides, things happen quickly now-a-days and with the War Department contracting for aeroplanes which can stay an hour in the air and carry two men, with the Wright Brothers' statement that they fly in an 18 mile breeze, with Delagrange's public flights before the King of Italy, with Count Zeppelin's colossal(aluminum) dirigible that carried twelve people for hours at a time, it seems as though the day of practical experiments in flying had arrived and that the chances of success have been increased to the point where speculative capital will invest in this new mode of locomotion.

9 10 11

A METHOD OF OBSERVING AIR DISTURBANCES PRODUCED BY THE BEATING OF THE WINGS OF A HOVERING FLY WITH A PROPOSED APPLICATION TO OUR WORK: by N.A. COBB.

(Dr. N. A. Cobb of the Department of Agriculture has been visiting at Beinn Bhreagh and has kindly consented to dictate a few notes for the information of the members of the A.E.A. concerning his method of observing the air disturbances produced by the hovering of a peculiar fly found in the Hawaiian Islands. He thinks that the method may possibly be of assistance to us in our work by enabling us to ascertain the nature of the disturbances produced by a rotating propeller etc. A rough diagram is appended illustrating the fly-box used by Dr. Cobb. The top and four sides of the box were of glass upon a baseboard of wood. The fly hovered in the middle of the box for considerable periods of time without touching the sides. The box was taken into a dark room and held in the path of a beam of sunlight admitted through a small hole. The arrow-head represents the beam of sunlight which passed through the box, and was received upon a screen of black absorbing material. Chalk-powder was then introduced into the box so as to make a smoky atmosphere. The diagram indicates the vacuous space observed surrounding the hovering fly. Dr. Cobb has thrown his notes and suggestions into the form of a letter as follows:—A.G.B.).

Beinn Bhreagh, Aug. 31, 1908: —Dear Dr. Bell;— I am writing this as the result of a suggestion following on one of our recent conversations.

Whether these remarks have any interest and value in aeronautics depends on how important it may be to have an accurate knowledge of what is taking place in the air during flight.

Up to the present our observations have been confined largely to the machine , that being the one thing that was easy to see, and, to a limited number of actual navigators, to feel.

During my observations on the flight of flies, as I have told you during our conversations, I chanced to notice a fly of the genus Volucella , standing still in the air under a tumbler in which it was held captive. This was a sort of 12

Dr. Cobb's chalk-powder box for observing the disturbance of the air produced by the wings of a hovering fly.

13 2 hovering, as we term it in birds, but one of these insects can stand so still in the air that it is possible to examine it with a reading glass, and thus decipher the antennae and other minute features, if one has the good fortune not to frighten the insect away, or has it in captivity as I had. I mention this reading-glass observation to give an idea of the

steadiness of the insect as it stands still in the air. Needless to say its wings are all the time vibrating several hundred times a second.

The tip of a fly-wing seven millimeters long probably travels at the rate of 5 to 10 meters per second when the wings are vibrating at the rate of two to four hundred times per second. I am assuming that the “figure eight” described by the wing-tip in one vibration is equal in length to the circumference of a circle of seven millimeters radius. Of course this is only an approximation, but it serves to bring out the fact that the rate of motion of the parts of an insect wing are in some instances comparable with those of the propellers now being used in flying machines, at any rate when the latter are being used at their lower speeds.

One conception of the fly when poised in the air is that of a partial vacuum of which the fly is the “nucleus”. Of course this partial vacuum, together with its insect nucleus has the same specific gravity as the surrounding air.

In form this vacuum is what would be expected from the action of the wings, i.e., it has a bilateral symmetry. From observations I have made, and speaking from recollection, it 14 3 appears to have somewhat the form of an ellipsoid of revolution (around the short axis of the ellipse as a fore-an-aft line), though my observations were far from complete and satisfactory

Measured in inches, a vacuum two by two by one would appear to be ample to support a fly of ordinary weight, say of from seventy-five to one hundred milligrams.

Another conceptions of the poised fly is that of an object supported by reaction in a column of downward moving air. This conception is supported by some of the evidence rendered by my dark box contrivance, the illuminated particles in which are seen to move downward more than in other directions.

Almost everyone must have noticed the motes floating in sunbeams seen against a dark back ground. A refinement based on this simple observation enables one to observe, to some extent the motions of air currents. If a sunbeam be passed through a darkened glass-sided box into which fine chalk-dust is injected, the white particles of chalk become strongly illuminated, if the room is darkened and the beam is caught on black velveteen or otherwise absorbed. As the motions of the dust coincide approximately with those of the air, it is possible, after a fashion, to observe the directions and intensities of the currents. By variously altering the apparatus it is possible to arrive at definite results, up to a certain point.

I believe it would be an interesting, and very likely profitable investigation to study, in such a box as I contrived the action of air currents under various conditions. The study of an insect poised in such a box would, I am positive from what I have already seen give valuable data, and as a matter 15 4 of fact I only await the right opportunity to repeat and extend my observations. Small motors in action in such a box might, I should think, yield results of value.

The particles move so rapidly that there is considerable difficulty in making the necessary observations and in getting the experience necessary to interpret the phenomena. Striking instances for first observations are the results when a cloud of dust slowly rolls, by, or up to, the region of disturbance. By piecing together observations of this kind much can be made out.

I have thought that a fine black wire lightly painted with glycerine if placed in the region of disturbance and allowed to be bombarded with chalk or other dust, might yield graphic records of value, but I have not tried this.

An instrument perfected on these lines should be called an “Anemograph”. When made quantitative, it would naturally be called an Anemometer, but as that term is already preempted for the instrument used to measure ordinary “horizontal” winds, it might be necessary to invent a new term. Probably a small and sensitive aneroid could be used to help in the interpretation of the anemograph until one became accustomed to its use. Have you ever wired an aneroid into various position in your kites and tried to read the pressures from a distance with an opera * - glass? I have an opera-glass that focusses down to six feet for such purposes. If you have not tried this and should have a curiosity to know what the air is doing in among the cells of the kites, I believe it would be possible to find out something this way. Again, if a kite of celluloid or 16 5 membranous cells were exposed in an artificially dusted wind, a graphic record might be obtained by first painting all the parts with glycerine. The same might be done on a smaller scale but more accurately with artificially created currents in the Laboratory.

It is a fact long since observed that the wings of insects, notably those of the best fliers, are usually covered on both surfaces with very minute hairs. I do not know that it has been experimentally proved what the function of these hairs is.

The hairs have their apices directed outward i.e., distally, though toward the inner margin of the wing they are deflected somewhat backward, using this term to indicate a direction at right angles to the principal vein of the wing.

It is perfectly obvious that that wing will be most efficient that will throw the air farthest. I more than suspect that the hairs on the surfaces of insect wings have the function of enabling the win ? g to get a better “bite” on the air or to better “seize” and direct the air, so as to throw it as far as possible. It might be thought that these minute structures would be too fine for this purpose, but it must not be forgotten that an insect's wings in action are sometimes moving in a rarified medium, the rarifaction being due to their own action. It might be a good idea to test on rapidly moving blades of air propellers the effect of surfaces similar to those on these insect wings. If it is desired to do this there are natural vegetable surfaces that could be veneered on propeller blades. Thus the surface of the sheaths of certain grasses, say those of some varieties of maize might prove suitable.

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MR. RUSSELL THAYER'S PROPOSITION TO PROPEL A BALLOON BY WIND PRESSURE AGAINST GYROSCOPIC RESISTANCE.

To Dr. A. G. Bell, President of Aerial Experiment Ass., Baddeck, Nova Scotia.

Philadelphia, Pa., Aug. 12, 1908 :— Knowing your great interest in modern Physics as practically applicable to the wants and benefit of man, I desire to submit to your consideration and candid criticism a discovery that I have recently made in regard to the Gyroscope and Airships.

In order to explain this matter simply and concisely I take pleasure in enclosing a copy of one of my Patents, which briefly explains the discovery.

At your convenience I should be much pleased to hear from you on the subject.

Russell Thayer. (M. Am. Soc. C.E.).

To Mr. Russell Thayer, Broad and Arch Streets, Philadelphia, Pa.

Baddeck, N.S., Aug. 24, 1908: —Your note of the 12th instant received. Your Patent 887, 443 contains a great thought, the practicability of which should be tested by experiment. It will give me pleasure to bring the matter to the notice of my colleagues in the Aerial Experiment Association.

Alexander Graham Bell.

NB. A copy of Mr. Thayer's Patent No. 887, 443 is appended.

18

No. 887,443. PATENTED MAY 12, 1908.

R. THAYER. DIRIGIBLE BALLOON, APPLICATION FILED DEC. 26, 1907.

2 SHEETS—SHEET 1.

FIG. I.

FIG. II.

WITNESSES:

Clifton C. Hallowell

Morris L. Jensen

INVENTOR: RUSSELL THAYER, by Arthur E. Atty.

THE NORRIS PETERS CO., WASHINGTON, D. C.

19

No. 887,443. PATENTED MAY 12, 1908.

R. THAYER. DIRIGIBLE BALLOON, APPLICATION FILED DEC. 26, 1907.

2 SHEETS—SHEET 2.

FIG. III.

FIG. IV.

WITNESSES:

Clifton C. Hallowell

Morris L. Jensen

INVENTOR: RUSSELL THAYER, by Arthur E. Atty.

THE NORRIS PETERS CO., WASHINGTON, D. C.

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UNITED STATES PATENT OFFICE.

RUSSELL THAYER, OF PHILADELPHIA, PENNSYLVANIA.

DIRIGIBLE BALLOON.

No. 887, 443. Specification of Letters Patent. Patented May 12, 1908.

Application filed December 26, 1907. Serial No. 408,002.

To all whom it may concern:

Be it known that I, Russell Thayer, of Philadelphia, in the State of Pennsylvania, have invented a certain new and useful Improvement in Dirigible Balloons, whereof the following is a specification, reference being had to the accompanying drawings.

In sailing a marine vessel, the effect of the wind pressure is controllable by utilizing the reactive effect of the water upon the vessel whereas, in ordinary balloons, there is no equivalent for the reactive effect of the water, and consequently such balloons must go with the wind unless provided with more powerful propelling means.

Therefore, it is an object of my invention to provide a balloon with means whereby a reactive force may be created and controlled local to the balloon, at the will of the operator, so as to be similar in effect to the reactive force of the water upon a marine vessel, in that by properly utilizing it, the balloon may be progressed, solely by wind pressure, in directions oblique with respect to the direction of the wind.

I have discovered that by utilizing the reactive gyroscopic force manifested upon any attempt to change the direction of the axis of a rotary body, in combination with the wind pressure upon a balloon floating in the atmosphere and carrying said body; that the movement of the balloon may be variably determined and controlled by correlation of the force developed by the gyroscope and the force of the air current. In other words, my invention provides means whereby wind pressure tending to diverge a balloon from a predetermined direction of traverse may be variably opposed by the gyroscopic effect of a rotary body carried by the balloon, under control of the operator, so that such wind pressure may be utilized to propel the balloon, in directions oblique to the direction of the wind pressure, as in ordinary marine navigation.

The gyroscopic reactive effect above contemplated is due to the fact that a rotary body tends to maintain constant its plane of rotation and consequent direction of its axis of rotation, such effect being increased or diminished in correspondence with the speed of rotation of the body. However, it is important to note that to render such reactive effect available as herein contemplated it is necessary to so mount the rotary body that its axis of rotation is free to oscillate, to a limited extent, in a direction parallel with the direction of said axis, for, when a body rotation upon a principal axis is subjected to a force tending to produce another rotation not parallel to the former, the resultant effect is such displacement of the axis of the original rotation, with respect to its support, as is most favorable to the parallelism of the two rotations, and, such displacement is a? right angles to the direction of the disturbing force.

In a balloon constructed in accordance with my invention as hereinafter described, the force due to the natural air drift, and the gyroscopic force created by controlled rotation of a suitable body carried by the balloon, may be so correlated, at the will of the operator, as to propel the balloon solely by the wind pressure, and in any direction except that directly and approximately opposed to such pressure.

I am of course aware that gyroscopes have been employed for many years and in various arts to balance or maintain the level or equilibrium of structures connected therewith, and therefore note that the gyroscope element of my invention has no such function or effect in the arrangement and operation which are characteristic of my invention as herein defined. I am also aware that it has been proposed to provide a marine vessel with gyroscopic wheels, but such wheels have been designedly arranged to maintain the horizontal planes of the vessel substantially stable, without opposing changes in the direction of traverse of the vessel. In other words, such devices of the prior art have been employed for a purpose radically different from that herein contemplated, and have been so constructed and arranged as to be incapable of the effects which are characteristic of my invention.

My invention comprises the various novel features of construction and arrangement hereinafter more definitely specified.

In the drawings; Figure I, is a side elevation of a balloon conveniently embodying my invention. Fig. II, is an inverted plan view of the balloon shown in Fig. I. Fig. III, is a plan view of the car shown in Fig. I Fig. IV, is a transverse sectional view of said car, taken on the line IV, IV, in Fig. III.

In said figures; the gas envelop I, which is of circular cross section, diminishing toward its stern, is conveniently connected by the bands 2, with the main frame 3. Said **2 887,443** frame supports the car 5, and has the vertical shaft 7, which supports the frame 8, of the sail 9, in a vertical plane. Said sail frame 8, comprises the bearing 11, mounted to slide on the boom bar 13, so that said frame 8, is supported for transverse oscillatory movement with respect to the main frame 3. The rudder frame 15, is mounted to oscillate transversely on the vertical shaft 16, in said frame 3. Said sail frame 8, is provided with flexible connectors 17, which extend around the pulleys 18, at the outer ends of said boom 13, to the rotary drum 19, in the car 5, and, the flexible connectors 21, extend from the rudder frame 15 around the pulleys 24, to the rotary drum 25, in said car. Said drums 19, and 25, are respectively provided with the hand wheels 27, and 28, whereby, said sail and rudder may be independently adjusted to different angles with respect to the longitudinal axis of the balloon.

Although I have shown the balloon provided with a sail and rudder which are adjustable with respect to the longitudinal axis of the balloon, at the will of the operators, as above described, so as to receive wind pressure in variable angular relation, it is to be understood that the balloon may be propelled in the manner described, without the employment of such adjunctive devices and solely by the wind pressure upon the balloon itself, and in this connection it may be observed that the envelop 1, is rendered more effective for its progressive movement by having its exterior converged toward is stern.

The rotary body 30, whose mass may be in any desired proportion to the mass of the balloon, is carried by the shaft 31, which normally extends substantially horizontal and parallel with the longitudinal axis of the balloon, and consequently parallel with the normal direction of traverse of the balloon. Said shaft 31, is mounted to rotate in the bearings 33, of the gimbal frame 34, and the latter is provided with oppositely extending trunnions 35, having a common axis of oscillation extending transversely above the center of gravity of said wheel and frame. Said trunnions 35, are journaled in the bearings 38, and so constructed and arranged that the oscillatory movement of said body is limited to approximately fifteen degrees. Said bearings are supported by the car, and may be adjusted and secured in variable relation with the longitudinal axis of the balloon, by any convenient means. The rotation of said body 30, may be effected and controlled by any convenient means. However, in the form indicated, said wheel comprises the armature of an electric motor having the field frame 40, carried by the gimbal frame 34, and said motor is energized by suitable connections with the source of power 41, controlled by the switch mechanism indicated at 42. It is to be understood that said body 30, may be rotated at variable speed, to produce and control its gyroscopic effect, so that said effect may be opposed to any force tending to turn the balloon from a path coincident with its longitudinal axis, and, that consequently any wind pressure upon the balloon, so received as to tend to change the plane of rotation and direction of the axis of said body 30, may be opposed by the gyroscopic effect of said wheel, so that such wind pressure may be utilized to effect the forward movement of the balloon in a direction oblique with respect to the direction of the wind, if desired, the direction of propulsion being also variably determinable, at the will of the operator, by adjustment of the angular relation of said sail and rudder with respect to the longitudinal axis of the balloon.

I do not desire to limit myself to the precise details of construction and arrangement herein described, as various modifications may be made therein without departing from the essential features of my invention, as defined in the appended claims.

I claim:—

1. In a balloon, the combination with levitating means; of a rotary body having its axis substantially horizontal; and means supporting said axis, permitting free but limited oscillatory movement thereof in a direction parallel with said axis; whereby wind pressure tending to turn the balloon from a predetermined direction of traverse, may be opposed by the gyroscopic effect of said rotary body, so that such wind pressure may be utilized to propel the balloon in directions oblique to the direction of the wind pressure.

2. In a balloon having its longitudinal axis substantially horizontal, the combination with levitating means; of a rotary body having its axis substantially horizontal and disposed transversely with respect to the longitudinal axis of the balloon; and means supporting the axis of said body, permitting free but limited oscillatory movement thereof in altitude; whereby, wind pressure tending to turn the balloon from a predetermined direction of traverse, may be opposed by the gyroscopic effect of said rotary body, so that such wind pressure may be utilized to propel the balloon in directions oblique to the direction of the wind pressure.

3. In a balloon having its longitudinal axis substantially horizontal, the combination with levitating means; of a rotary body having its axis substantially horizontal; means supporting said axis, normally preventing azimuthal movement thereof while permitting free but limited altitudinal oscillatory movement thereof; whereby, wind pressure tending to turn the balloon from a predetermined direction of traverse, may be opposed

by the gyroscopic effect of said rotary body, 21 **887,443 3** so that such wind pressure may be utilized to propel the balloon in directions oblique to the direction of the wind pressure.

4. In a balloon, the combination with levitating means; of a rotary body having its axis substantially horizontal; means supporting said axis, permitting free but limited oscillatory movement thereof in a direction parallel with said axis; and, means adjustable with respect to said axis, arranged to receive wind pressure in variable angular relation, whereby wind pressure tending to turn the balloon from a predetermined direction of traverse, may be opposed by the gyroscopic effect of said rotary body, so that such wind pressure may be utilized to propel the balloon in directions oblique to the direction of the wind pressure.

5. In a balloon, the combination with a rotary body; of electrical means to rotate said body at such speed as to produce a gyroscopic effect; and, means supporting said body, so that it has a freedom with respect to an axis eccentric to the axis of rotation of said body, substantially as set forth.

6. The combination with a rotary body; of means to rotate said body at such speed as to produce a gyroscopic effect; and, means supporting said body, so that it has a freedom with respect to a horizontal axis eccentric to the axis of rotation of said body, substantially as set forth.

7. The combination with a rotary body of means to rotate said body at such speed as to produce a gyroscopic effect; and, means supporting said body, so that it has a freedom with respect to a horizontal axis eccentric to and above the axis of rotation of said body, substantially as set forth.

In testimony whereof, I have hereunto signed my name at Philadelphia. Pennsylvania, this 24th day of December 1907.

RUSSELL THAYER.

Witnesses:

Edwin J. Mole,

Hiram Barnes.

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AGREEMENT OR ORGANIZE THE AERIAL EXPERIMENT ASSOCIATION.

WHEREAS, the undersigned Alexander Graham Bell of Washington, D. C., U.S.A., has for many years past been carrying on experiments relating to aerial locomotion at his summer Laboratory at Beinn Bhreagh, Near Baddeck, N.S., Canada, and has reached the stage where he believes that a practical aerodrome can be built on the tetrahedral principle driven by an engine and carrying a man, and has felt the advisability of securing expert assistance in pursuing the experiments to their logical conclusion and has called to his aid Mr. G. H. Curtiss of Hammondsport, New York, an expert in motor construction, Mr. F. W. Baldwin, and Mr. J.A.D. McCurdy of Toronto, Engineers and 1st Lieut. T. Selfridge, 5th Field Artillery, U.S.A., Military Expert in Aerodromics, and

WHEREAS it has been thought advisable that the undersigned should work together as an Association in which all shall have equal interest, the above named gentlemen giving the benefit of their assistance in carrying out the ideas of the said Alexander Graham Bell, the said Alexander Graham Bell giving his assistance to these gentlemen in carrying out their own independent ideas relating to aerial locomotion, and all working together individually and conjointly in pursuance of their common aim “to get into the air” by the construction of a practical aerodrome driven by its own motive power and carrying a man.

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2 Now therefore we the undersigned, Alexander Graham Bell, G. H. Curtiss, F. W. Baldwin, J .A.D. McCurdy, and T. Selfridge do hereby agree to associate ourselves together under the name of the “Aerial Experiment Association”, for the purpose of carrying on experiments relating to aerial locomotion with the special object of constructing a successful aerodrome.

We agree that the “Aerial Experiment Association” shall be organized on the first day of October, 1907, and shall exist for the term of one year from the date of organization unless otherwise determined by the unanimous vote of the members

We agree that the inventions relating to aerial locomotion made by the members of the Association during the lifetime of the Association shall belong to the Association; and that any applications for letters patent for such inventions shall be made in the names of all the members as joint inventors.

We agree that inventions relating to aerial locomotion made by the members of the Association before the organization of the Association shall belong to the inventors, and not to the Association, unless specially assigned; and that only such prior inventions shall be claimed by individual members as shall be substantiated by the production of written memoranda, drawings, photographs, or models existent before the date of the organization, so that the proofs of prior invention shall not rest on recollection alone, or upon verbal statements unsupported by documentary or tangible evidence of earlier date than the organization of the Association.

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3 The said Alexander Graham Bell agrees to place his Laboratory at Beinn Bhreagh, Near Baddeck, Nova Scotia, at the disposal of the Association for the purpose of carrying on experiments relating to aerial locomotion, together with all the buildings, tools, materials, and appurtenances belonging to the Laboratory, without charge, so long as the Association desires to carry on experiments at Beinn Bhreagh: Provided that the

running expenses of the Laboratory, including the salaries of the Superintendent and men employed shall be paid by the Association during their use of said Laboratory, the number of men employed other than the Superintendent to be at the discretion of the Association, and that any new material or apparatus not in the Laboratory at the date of the organization which may be desired for the use of the Association shall be acquired at the expense of the Association.

We, the undersigned agree to appoint one of our number as Director of Experiments to be our medium of communication with the Laboratory.

We agree that the Laboratory workmen shall receive their instructions from the Superintendent of the Laboratory alone, that the Superintendent of the Laboratory shall receive his instructions from the Director of Experiments alone, and that the Director of Experiments shall receive his instructions by vote of the Association of which he is a member.

We agree that the headquarters of the "Aerial Experiment Association" shall be at Beinn Bhreagh, Near Baddeck, Nova Scotia, and that on or before the first of January, 1908, 25 4 the headquarters of the "Association" shall be removed to some place yet to be determined within the limits of the United States.

This agreement can only be modified by unanimous vote of the undersigned.

Witness our hands and seals at Halifax, Nova Scotia, this thirtieth day of September, A.D., 1907.

(Signed) Wm. L. Payzant, Notary Public, Nova Scotia.

(Seal)

(Signed) Alexander Graham Bell (Seal)

(Signed) G. H. Curtiss (Seal)

(Signed) F. W. Baldwin (Seal)

(Signed) J. A. Douglas McCurdy (Seal)

(Signed) T. Selfridge (Seal) 1st Lieut. 5th F. A., U.S.A.

Authenticated by David F. Wilder, Consul General of the United States, September 30, 1907.

BULLETINS OF THE Aerial Experiment Association

Bulletin No. XI Issued MONDAY SEPT 21, 1908

ASSOCIATION'S COPY

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN NO. XI ISSUED MONDAY SEPTEMBER 21, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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THE FUTURE OF THE A. E. A.

Time passes rapidly, and the 30th of September, the day assigned for the dissolution of the Association in our agreement of organization, will be upon us almost before we know it.

Aerodrome No. 4, McCurdy's Silver-Dart, is practically completed, and the first experiments with it may perhaps be made in time to be noted in this Bulletin.

Aerodrome No. 5 and No. 6 are advancing rapidly, but it is pretty certain that experiments with them can not be made before September 30. It seems therefore advisable that the Aerial Experiment Association should be continued after the 30th of September for a sufficient length of time at least to enable us to complete and test the aerodromes we now have on hand (Nos. 4, 5 & 6). In the event of the failure of 5 & 6 it would be well for the Association to continue experiments on the same lines until we have succeeded in putting a tetrahedral structure into the air, propelled by its own motive power and carrying a man. For this was the problem with which we originally started and we should pursue the problem to a successful issue.

The experiments in this direction were interrupted in December 1907 by the destruction of the “Cygnet”, and the lateness of the season, and the summer was well advanced this year before they could be resumed here, on account of Mrs. Bell's illness which prevented me from coming to Beinn Bhreagh until quite late in July so that the experiments did not really begin until August. For this reason the tetrahedral experiments have 2 2 been delayed much more than we anticipated in December 1907, and it becomes obvious that we cannot complete aerodromes No. 5 and No. 6 before the date set for the dissolution of the Association.

It is therefore proposed to have the following resolution voted upon at the meeting of the Association September 30, 1908:—

Resolved :— that the Aerial Experiment Association be continued for another period of six months ending March 31, 1909, the Association then to be dissolved unless other plans are unanimously agreed upon by the members.

I would also propose the following resolution in the event of the continuance of the Association:—

Resolved :— That Mr. Wm. F. Bedwin, Superintendent of Beinn Bhreagh Laboratory, be admitted as a member of the Association with all the rights and privileges of the original members; and that the present organization in all other respects be continued.

I think that Mr. Bedwin's services to the Association in the construction of our Hammondsport aerodromes, in the construction of the "Cygnet" at Beinn Bhreagh, and in the Superintendency of the work of Beinn Bhreagh Laboratory merits this recognition by the Association.

Assuming for the present that the Association will be continued for another limited period of time it would be well to restrict the work of the Association as much as possible to the utilization of tetrahedral structures in practical aerodromes and subordinate other plans until we have succeeded in placing a tetrahedral aerodrome in the air. This would be advisable for two reasons:—

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3 (1) It was the original object of the Association; and has only been carried out as far as the construction of the kite "Cygnet".

(2) The Association will have no difficulty in securing good patents upon aerodromes embodying tetrahedral structures, subordinate only to a broad patent covering tetrahedral structures which was granted to A.G. Bell, now the Chairman of the Association.

So much work has been done by other people upon plans for aerodromes having the general features of our first four aerodromes, the Red Wing, White Wing, June Bug, and Silver-Dart, that it is extremely doubtful whether patents of any great value can be obtained to represent our work at Hammondsport. We are liable to come into contact with numerous patents; and should any patents we obtained turn out ot be subordinate to other patents already granted, the owners of these patents, not being affiliated with the Association would be liable to make trouble.

When the Association finally dissolves the only way in which the members can obtain any substantial reward for their labors will be by the manufacture and sale of aerodromes embodying features produced by the Association. This means either that the Association must be converted into a manufacturing corporation, or that the Association will sell out its rights to some manufacturing company for a consideration in shares or cash. Now no company will give the Association anything for its invention unless they are patented, or at least patentable. What we would sell to such a company would be patents or patentable inventions. Anyway patents would be 4 4 involved and it should, therefore, be the special object of the Association during the remaining months of its existence to work — not simply, as formerly “to get into the air” by any means we can — but to get into the air by new means of a patentable nature. Upon our success in doing this will depend whatever future the Association may have before it. The Association cannot be continued indefinitely upon the present basis on account of the expense incurred without reimbursement.

If we can produce a new form of aerodrome with distinctly patentable features; and a company could be found or formed, with capital behind it, to put our inventions into commerical use, the Association could be reimbursed for its expenditures out of the proceeds received from the company.

It would then be for the Association to decide what should be done with the proceeds:—

(1) The Association might decide to distribute the proceeds in accordance with our agreement of organization and dissolve the Association.

(2) It might decide to continue the Association indefinitely putting the proceeds into the treasury of the Association for the support of its experimental work.

(3) It might also decide to enlarge the membership o the Assoc ? iation and establish it as a permanent institution or society to promote the art of aviation.

This third plan would be my desire. But I realize that the possibility of such a scheme depends upon the possibility of securing patents controlling new and useful features of commercial value. We have begun well and the success of our work has attracted the attention of the world to the 5 Aerial Experiment Association as an important and valuable agency in promoting the art of aviation. I would like, therefore to see the Association placed upon a permanent basis with sufficient capital to enable it to extend a helping hand to all worthy investigators who are struggling, with insufficient means to advance the art by experimental methods.

I would, therefore, urge that we should all have this great object in view, and bend all our efforts during the next six months to the development of practical improvements of a patentable nature to the end that we may be reimbursed sufficiently to enable us, or some of us, to endow the Association and extend a helping hand to others who may be seeking to advance the art of Aviation by experimental methods.

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TELEGRAMS FROM MEMBERS .

McCurdy to Bell .

Hammondsport, N.Y., Sept. 6, 1908: — Made short jump to-night in June Bug using double-decker. Control 15 feet in front of main planes. Works beautifully.

J.A.D. McCurdy.

Curtiss to Bell .

Hammondsport, Sept. 9, 1908:— Flew one half mile to-night with four cylinder improved June Bug. See letter.

G. H. Curtiss.

Bell to Orville Wright .

To Orville Wright, Fort Myer, Washington,D.C.

Baddeck, Sept. 11, 1908 :— On behalf of the Aerial Experiment Association allow me to congratulate you upon your magnificent success. An hour in the air marks a historical occasion.

Graham Bell.

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EXTRACTS FROM LETTERS FROM MEMBERS .

Curtiss to Baldwin .

(About motors for flying Machines).

Hammondsport, N.Y., Aug. 26, 1908 :— Your scheme for an upside down engine is all right. However, for light construction, cylinders should not be placed in line. I am now satisfied that nine connecting rods can be attached to one crank shaft and an air-cooled engine of about two pounds per horse-power which will cool constantly would result. For larger cylinders, we will have to use water c - cooling and the upside down business might come into play.

Closed crank cases have many advantages on small engines. The ope m n cases would be the thing for 50 to 100 horse engines of four or more cylinders in line. At any rate the suggestion is good and we will keep it in mind.

I am anxious to know what you are doing. We seem to be getting along very slowly here. I must say, however, that the number 4 is going to be a finished article, and will have no home made appearance. We expect to fly the June Bug again to-morrow having put new ribs in. The old ones straightened out until she refused to fly.

Our man over at Ithaca has been trying his luck, but his luck has not been good so far. I understand he went 40 feet.

Under separate cover we are mailing a print of the Peerless. You will note it has grown some.

We are working hard on a 50 horse, 8 cylinder, water-cooled. Can you give me an idea of what engine will be wanted at Baddeck.

G.H. Curtiss.

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McCurdy to Bell. .

(About Herring's Method of calculating horse-power).

Hammondsport, N.Y., Sept. 3, 1908 :— Mr. Herring told me that he could reckon the horse-power of his engine in this manner:—

Take the speed of your machine while driven by your motor, in feet per second; multiply this result by the push of your propeller in lbs., and divide by 550 to reduce it to horse-power per second, and this gives you the required result. For the propeller, it was found by Maxim, produced the same push when advancing that it did at standstill in a sling (?), and the distance the machine advanced in a given time would depend upon this push (for the same machine): Hence the product of feet and lbs. would give horse-power if divided by the proper constant, 550 for ft lbs per second, or 33000 for ft lbs per minute.

Now apply this to our machine:— Speed 40 miles per hour = 40 X × 5280/3600 ft per second. Push of propeller 210 lbs (aver) Hence horse-power produced = 40 × 5280/3600 × 210/550 = 22.4 h p.

Now Baldwin will remember that we figured the horse-power of our engine by taking into account its bore, stroke and compression, and number of cylinders, as 22 to 23 horse-power; and the above method agrees with this result.

J.A.D. McCurdy.

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CURTISS TO BELL .

(About Orville Wright's Machine).

Hammondsport, N.Y., Sept. 7, 1908: — I have been down to Washington for two days, called there by a message from Gen. Allen. I was lucky enough to arrive just in time to see the Wrights' flights, Thursday and Friday.

The first flight was rather short as Mr. Wright said he was unaccustomed to the machine, and the levers seemed awkward for him. He made a wrong move and headed for the tent, which necessitated immediate landing; in this landing, with the machine tilted somewhat, one rudder struck first causing the machine to swing around sideways and broke the rudder off.

The next day he did better, however, and made as fine a landing as you would make on wheels. The launching device, which includes a derrick, and a big weight which drops the pulleys and rope to give the initial velocity, does not seem to be very well liked, and I believe that all who have seen our machine and the Wrights' prefer our method of starting on wheels to skids.

I had some talk with Mr. Wright and nothing was said about his patents on adjustable surfaces. He has nothing startling about his machine and no secrets.

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The surfaces have a plain curve; that is, they appear like a segment of a circle.

The front longitudinal strips are very heavy and flat, and no attempt is made anywhere on the machine to reduce resistance by any improved form of body.

The struts are nearly square, with the corners slightly rounded off. The front control has a new action: The ribs are flexible and bend. I cannot see there is any advantage in the movement, however.

The propellers are also odd: They are very flat at the hub, presenting great resistance as they revolve. The blades are wider towards the ends, perhaps three times the width at the hub, and there is a curve to each blade as follows:—

The two propellers are about nine feet in diameter, and are driven in opposite directions by crossing one chain. This is accomplished by running the chain through a steel tube, 11 3 the slack side going out around the one which does the pulling.

The engine is the same they had four years ago, being rather crude and not exceptionally light. Mr. Wright sits to the left of the engine just inside of the front surface on a little cushioned seat, which is large enough for two.

Mr. Wright told me they intended to use but one propeller hereafter, presumably to simplify. This double-chain transmission they have weighs 100 lbs. more than the single propeller would.

Selfridge has been ordered to St. Joseph, Mo. to fly the Government airship at the coming maneuvers. After that he will probably fly the Wrights' machine.

Mr. and Mrs. Fairchild were out to the flight, and I had a nice visit with them.

I enclose a brief description of what we have been doing here since the last report.

G. H. Curtiss.

NB. See report of Hammondsport Laboratory AGB).

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Curtiss to Mrs. Bell .

Hammondsport, N.Y., Sept. 9, 1908 :— I had a short, but pleasant, visit with Mr. and Mrs. Fairchild in Washington the other day. I was there for two days in response to a message from Gen. Allen to get the Government's motor ready for the St. Joseph tournament.

One of the Wrights made a flight each day, the first and only two they have made so far. The first day's flight was marred by a bad landing which broke one of the skids. The second was better lasting for over four minutes. It is plain to see that they have nothing new, or better than we. I wrote Mr. Bell describing the machine.

Our number four will be, I believe, both better in appearance and in results than any yet produced. The new engine will have power and endurance for long continued flights, and we hope to make new records as soon as it is ready.

We have been experimenting with the June Bug and have gotten good results without the tail and with a new front control. Under separate cover I am mailing a print showing this new control.

G. H. Curtiss.

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CURTISS TO BELL .

Hammondsport, N.Y., Sept. 11, 1908 :— Explaining our message of yesterday, wish to say that as the weather was favorable and a number of out-of-town people were desirous of seeing a flight of the “June Bug”, I went to the track at six o'clock in the evening, took the machine out, and flew for the first time with the new rudder and front controls as per the illustration.

The interesting feature of the flight was the fact that I had no sooner gotten in the air than four cylinders ceased running; caused by the breaking off of the gasoline pipe which feeds the four cylinders on one side. This pipe had been recently put in by the boys as they thought the old one might be too small. The big one did not stand the vibration I knew immediately what had happened, and thought it would be a good opportunity to see how near I could come to flying with only four cylinders running. To my surprise, I kept on going and I made a good hal n f mile, including quite a turn, with four of the eight cylinders working, which means that less than half the power was being developed. The number of revolutions did not decrease to the same extent, as the speed was over thirty miles an hour, and the propellers turned much more easily than when standing.

The last Bulletin has been received and contents gone over carefully. I shall prepare to be present at the meeting called for Sept. 30th at Beinn Bhreagh, with my report.

The summary of the experiments to date on the tetrahedral aerodrome, and the prospects for the No. 5, are most 14 2 interesting and instructive. The recent flight of the “June Bug” with but four cylinders running, Mr. Wright's flights of an hour alone, and shorter time with Mr. Lahm aboard, furnish data as to the power required in aerodromes of this type. By making deductions, required power for the tetrahedral-cell structure may be obtained with reasonable accuracy.

With this information Curtiss Co. would be willing to undertake construction of a motor of sufficient power and light enough weight to accomplish the purpose. The engine for No. 4 will develop 50 H. P. and weigh, complete with the radiator and water, about 225 pounds.

G. H. Curtiss.

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BALDWIN TO CURTISS .

(About plans for Aerodrome No. 6).

Beinn Bhreagh, Near Baddeck, N.S., Sept. 14, 1908: — I want to give you a little idea about plans for aerodrome No. 6. We hope to put this machine in the air in a new way. The aerodrome will be fitted with a boat instead of on wheels or runners and we hope to get enough speed over the water to enable us to rise into the air. At present all our efforts have been concentrated on the first and what seems the most difficult part of the combination, a successful hull. If we can get a hull either by the use of hydroplanes or aeroplanes or both, which will make about 20 miles an hour, I think we can easily evolve an aerodrome of the water-fowl type which will rise from and land on the water.

As you know we have built a very light hull to see what speed we can get over the water. The hull itself is a long narrow shell with very easy lines and depends upon two out-riggers for stability. She is 20 feet long by 1 foot 3 and carries her maximum beam and displacement seven (7) feet from the bow. The bow itself has a flat over-hang to keep her from diving under the influence of the high line of thrust made necessary by aerial propellers.

This boat offers remarkably little resistance and goes through the water very cleanly with little or no wave-making resistance up to 10 miles an hour. We towed her at various speed taking the tow-line pull as the measure of her resistance. The results of the towing experiments led us to expect a speed of about 16 miles an hour with an 80 lb pull. She was then fitted 16 2 with an aerial propeller 140 cm diameter and 1.5 m pitch, and the little four cylinder engine we have here. This?ave us about 85 lbs thrust. The boat was then tried and with the engine working well made 15 miles an hour. At a speed of 15 miles an hour, which is exceptionally high for a hull only 20 ft long, the wave-making effects were quite marked and it is doubtful if very much higher speeds can be obtained even with greater horse-power unless we reduce our displacement. This can be done either by hydroplanes or aeroplanes. The hydroplanes would seem to have the advantage in compactness and possibly in efficiency, but the aeroplanes will give us stability and of course, will be a necessary part of the full-fledged water-fowl aerodrome which we hope to develop. In the few experiments which we made with the directly driven propeller, the torque made itself felt and the elevated position of the engine led us to look more or less anxiously to the future stability of the machine should we lift out of the water. Stability calls for two changes, (1) the lowering of the engine to keep the center of gravity low and (2) the elimination of torque action by the use of two oppositely rotating propellers. We installed your mitae-gear reversing mechanism and lowered the engine about 2 ft. The propellers we are using now are 2 meters diameter, and about 8 ft pitch. This geared 4.4 to 1 does not seem to load the engine sufficiently as it will turn up 1700 rpm and a thrust is only about 110 lbs. What speed we will get out of this has not been determined, but it does not seem that the thrust is satisfactory and we will try different propellers or different gearing of the same propellers until 17 3 we get a better result before trying the boat over the water.

The aero-surfaces we have in mind will be of the Oionos type you are familiar with. We chose this because it seems more efficient than any we know of at present and until we get into the air we do not propose to worry over stability. It will be made of meter or meter and a half cells of one-half inch fish-shaped material wired laterally in a way we have found most efficient in small 50 cm cells. The corner pieces offered some little difficulty for neat construction but we are now making them of aluminum after a pattern got out two years ago for metallic cells and while improvements can doubtless be made upon them they will do very well for our first structure.

As soon as we get a little more information from the behavior of the Dhonnas Beag we intend to build a longer one which will be the body and hull for aerodrome No. 6. We can build a hull 30 ft long which will be very strong, and give admirable rigidity to the attachment of bow control, weighing not more than 100 lbs. If the engine and aero-surfaces are placed about one-third from the stern the bow-control can be placed about 20 ft in advance of the front edge of the supporting surfaces. The arrangement for the front control has not been decided upon yet but I would like to see both up and down and right and left steering accomplished by it. We have in mind a universal front-control either swung in gimbals or in a ball and socket joint; but perhaps this will be a little too com - p licated and we may resort to a double-decker witha right and left rudder swung between its surfaces. Hydroplanes so far have been very discouraging. We have used large wooden 18 4 planes and small metal ones. The metal ones are stepped somewhat after the fashion of a venetian blind.

I enclose a drawing giving a crude idea of the nature of aerodrome No. 6 so far as developed. F. W. B.

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Plans for Aerodrome W. 6 by F.W. Baldwin

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A SUMMARY OF THE WORK AT HAMMONDSPORT LABORATORY FROM JULY 4 TO SEPT. 1, 1908: by G. H. Curtiss, Director of Experiments.

As we have become more proficient in handling flying-machines, and desire to make longer flights, it is thought advisable to fit the number 4 with an engine having a surplus of power, and a positive cooling system. Such a type of engine would ultimately by necessary on all successful machines, therefore, we have decided to build and equip the number 4 with this motor.

It is an eight cylinder, water-cooled, with a 3 ¾ bore, and four inch stroke. It will weigh about 160 lbs and be rated at 50 H P. Our shops are running night and day on this motor, for which the machine is practically ready.

During the construction of the number 4, series of experiments have been carried on with the old “June Bug”, with a view of incorporating any improvements we could make in the latest machine. The tail has been entirely removed, one surface at a time. The removal of the upper surface seemed to have little effect, but with both surfaces taken away, and the frame only remaining, there is a marked difference in the handling.

Both Mr. McCurdy and I rode it in this way making short flights. After the first flight we became more accustomed to it, and finally learned to keep it on very even keel, and with the framework o ? f the old tail entirely removed we have turned in a smaller circle than before. The principal advantage of rem ? o ving the tail is the increase of speed, and it was decided to use no tail on number 4.

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2 To off-set the slight instability a new front control has been made, and placed o 1 7 feet forward of the main surface. This control has two surfaces 30 inches wide and eight feet long.

A short flight was made last evening in which it appeared to work nicely and be a good improvement. Owing to the wind no turns were attempted.

Another experiment was made in connection with the surfaces. This was to do away with the reverse curve. The original ribs had become flattened, making it necessary, if further flights were attempted, to make new ribs. In doing this we changed the form, and fitted ribs which were straight except for the usual curve at the forward end, which was slightly increased. An improvement both in lifting and in gliding was immediately perceptible. G.H.C.

NB. This report was enclosed in the letter from Curtiss to Bell dated, Sept. 7, 1908. A.G.B.

22

WORK OF BEINN BHREAGH LABORATORY By Wm. F. Bedwin, Superintendent.

All the sections for aerodrome No. 5 are made up and beaded with light beading and the whole has been assembled into a machine and the ridge is beaded. I am now getting material ready to start on the main beading on the apparatus. (Photograph appended).

We have under construction the full sized model of the beading sticks for center part of machine. This is made up for the purpose of studying the strength, etc. of the section.

We have the double propellers set up on the Dhonnas Beag with chain drive from engine to propeller shaft. Several experiments with these propellers show a pull of 100 lbs. against a pull of only 80 lbs with the single propeller.

We have men at work on a model of No. 6 aerodrome, and it is progressing rapidly.

Have Mr. M. C. McLean at work on an idea of his own for a propeller that can be expanded during rotation.

Trying an experiment in enlarging photographs for Bulletins. I have had tested Dr. Bell's fleurescent screen with the X-Ray apparatus at Sydney and found it in good order.

I am making a new pair of double propellers for the Dhonnas Beag; have just started on these to-day. The exact diameter and pitch has not yet been decided upon.

The hydroplanes with the extra blades on are ready for attachment to the Dhonnas Beag. (photograph appended).

23

Have the men at work on the Gauldrie's engine which was sent to us in bad repair. Will have the boat out in a few days now.

We had the pleasure of a call from the Nova Scotia Press Association on the 17th at the Laboratory. There were about 15 in the party. W.F.B.

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Present condition of aerodrome No. 5.

25

A Study for the Body of aerodrome No. 5. 162 1908 Sept 18 ?

26

Two Propellers.

27

Bedwin holding double propellers and gearing.

28

Three hydroplanes.

29

Nova Scotia Press Association.

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EXPERIMENTS WITH THE DHONNAS BEAG: by F.W. Baldwin.

Sept. 1, 1908 :— Made preliminary experiment on Dhonnas Beag with hydroplanes. The hydroplanes were made of iron about 5 32nds of an inch thickbeing superposed somewhat after the fashion of a venetian blind (see photograph Bulletin IX p. 18) Three sets of planes were used, two forward and one aft. Each set carried two planes 25 cm wide, and 4 cm deep. This gave a total hydroplane surface of 600 sq cm.

The planes were set at an angle of 5° with the deck of the boat. This gave them a slightly greater angle of incidence owing to the fact that the boat trimmed somewhat down by the stern when under way.

There was a fresh wind blowing down the harbor when the boat was launched shortly before five o'clock. Engine was started and boat released. She seemed slow and sluggish, the hydroplanes and their attachments making a great deal of fuss.

No very satisfactory observations as to speed or lift of hydroplanes were possible, as the boat exhibited a marked tendency to swing off to starboard, and for some reason would not respond to her helm. The engine had to be shut off to avoid going ashore, and a new start was made. This time from the middle of the harbor. Exactly the same manuever was repeated, and experiments had to be given up as the boat would not steer.

A lot of eel-grass collected on the planes, and this undoubtedly reduced her speed and may have had something to do with the bad steering.

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2 Sept. 3, 1908 :— Tried Dhonnas Beag with hydroplanes arranged as before. Engine worked nicely. No wind and smooth water in harbor. The forward hydroplanes made a

great deal of fuss, splashing up a lot of water all over the boat. About half way down 100 course engine stopped suddenly, (probably due to water short circuiting batteries). Boat showed some marked tendency to steer off to starboard, so towed her back and hauled out for inspection.

Planes were slightly twisted in a way which would count for her steering to starboard, and so were straightened up. As no lift had been perceptible in previous experiment we tried planes at a much greater angle, (increased from 5° to about 25°). Boat now steered well, and return trip was made, Engine worked well, but speed of boat was markedly slower than before and no lift was manifest.

Sept. 10, 1908 :— Double propellers were finished on Dhonnas Beag to-day (see photograph Bulletin No. XI p 34). Boat seemed to settle slightly when put in the water, and when engine was started up suddenly began to sink. Boat had to be hauled up; found vibration of engine had opened up long crack in bottom, which was badly warped. Experiments had to be postponed.

Sept. 12, 1908 :— The Dhonnas Beag has been repaired in hopes of making her water-tight. Engine fitted with double propellers; experiments made at aerodrome wharf to test the pull. Propellers are 2 meters in diameter with a pitch of about 8 feet, probably 22 ½° at tip skeleton form.

Exp. 1. Engine turned over 1700 rpm. Gearing of propellers was 4.4 to 1; maximum pull 117 lbs; steady pull of 32 3 115 lbs, vibration was very great, had to stop experiments to stiffen up engine-bed and propeller supports.

Exp. 2 Same gearing and propellers as before; pull maximum 110 lbs; steady 105 lbs.

Exp. 3 Maximum pull 105; steady pull 100. Boat found to be still leaking. Experiments had to be given up.

Sept. 16, 1908 :— Tried thrust of double propellers on Dhonnas Beag with a view to getting some higher efficiency before making a trial over the water. Propellers geared 24-9 about 2.7.

Exp. 1 Maximum pull 100; steady pull 80; engine not tuned up.

Exp. 2 Maximum pull 110; steady pull 100.

Exp. 3 Maximum pull 100; steady pull 100.

Exp. 4 Thought we would try effect of taking off one propeller, so unshipped after propeller which was the one directly driven rotating in the same sens as the engine. With only one propeller the engine speeded up. Maximum pull 77.7; steady pull 70.

Exp. 5 Put on both propellers again and took rotations and pull. Maximum pull 100; steady pull 100; rotations 487 in 30 seconds equals 974 rpm.

Exp. 6 Thought we would relieve the engine of some of its load to try and get more speed on the propellers. Cut off a little more than an inch from the after edge of propellers, and took rotations and pull. The engine seemed to work as well as before, but for some reason did not turn the propellers any faster in spite of their reduced area 34 4 and the pull fell off considerably. Maximum pull 90; steady pull 85; rotations 487 in 30 seconds equals 974 rpm.

We decided to have a trial of the Dhonnas Beag on the water just as she was, before we lost any more thrust by further experiments. Started off down the 100 meter course with a five r or six mile breeze. Did not have time to advance spark to speed the engine up before being well started on course, so let her run course with retar t ded spark. 100 meters in 18 seconds. Turned around and came back against the wind with engine speeded up. 100 meters in 18 seconds.

Exp. 8 This time had the engine going full speed both ways. With wind 100 meters in 15 seconds; against wind 100 meters in 18 seconds.

It was surprising how little effect the speeding up of the engine made. The thrust with the engine speeded up was probably 50% more than with engine running slowly, and yet there was only 3 seconds difference in speed of boat in 100 meter course.

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134 Dew. 1905 Sept 2

Double propellers on Dhonnas Beag.

35

THAYER T B O BELL .

Broad and Arch Sts., Phil. Sept. 11, 1908 :— I beg to acknowledge the receipt of your kind favor of the 26th ultimo, and appreciate your consideration of the matter. I have constructed the deck of a small dirigible to which the gyroscope is properly attached, and subjected it to tests in a room, and it certainly bears out my theory as explained generally in my patent.

These small preliminary tests that I have made indicate very clearly to me and to several Engineers who have witnessed them, that I have solved the problem of control of a balloon. I should be much pleased to hear of the result of the discussion when the matter has been brought before the Association.

Russell Thayer.

36

A letter from Mr. Orville Wright acknowledging receipt of Dr. Bell's telegram and thanking the Aerial Experiment Association for their message of congratulation has been received.

It is impossible to insert it here, as Dr. Bell carried the original with him in his Note Book to Washington C.R.C.

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POSTSCRIPT: by Charles R. Cox.

This Bulletin is issued without Dr. Bell's last revision, as he and Mr. Baldwin left for Washington before it was completed.

I append telegram sent by Dr. Bell from Grand Narrows, N.S., as he was boarding the train for Washington, to Curtiss and McCurdy, in relation to meeting of the members of the Aerial Experiment Association at Washington, D.C., also telegrams announcing the death of the Secretary of the Aerial Experiment Association, and expressions of sympathy received.

Telegrams .

To Curtiss and McCurdy, Hammondsport, N.Y.

Grand Narrows, N.S., Sept. 18, 1908 :— Let us have a meeting of the Association in Washington as soon as we can all reach there. Too stunned to say more at present.

Graham Bell.

To A. G. Bell, Baddeck, N.S.

Washington, D.C., Sept. 17, 1908 :— Wright aeroplane wrecked to-day. Propeller broken; fell over one hundred feet. Selfridge seriously injured. Wright's leg broken.

Charles Bell.

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To A. G. Bell, Baddeck, N.S.

Washington, D.C., Sept. 17, 1908: — Poor Tom died to-night of brain injury in wrecked aeroplane. A new propeller broke. Wright stopped engine, but aeroplane pitched forward and dove 50 feet. Wright broke thigh and two ribs. He will recover. Machine completely wrecked.

David Fairchild.

To A. G. Bell, Baddeck, N.S.

New York, N.Y., Sept. 18, 1908 :— Please accept deepest sympathy in loss by Association of Selfridge.

E. L. Jones.

To A. G. Bell, Baddeck, N.S.

Hammondsport, N.Y., Sept. 18, 1908 :— Selfridge died eight P.M. last night.

G. H. Curtiss.

To Prof. Bell, Baddeck, N.S.

Sydney, N.S., Sept. 18, 1908 :— Can you send briefly particulars and statement regarding death of Lieut. Selfridge at Washington.

Sydney Record.

To Editor Sydney Record, Sydney, N.S.

Baddeck, N.S., Sept. 18, 1908 :— Dr. Bell and Mr. Baldwin have left to attend funeral. Telegrams received state a new propeller broke. Wright stopped engine but aeroplane pitched forward and dove fifty feet. Selfridge died eight P.M. from brain injury. Wright broke thigh and two ribs, but will recover Although Selfridge was only twenty-seven he had already distinguished himself commanding United States Marines in San Francisco earthquake; ascended in Dr. Bell's man-carrying kite “Cygnet”, a feat never before performed. The White Wing, the first A.E.A. aerodrome was built under his direction and flew successfully. His loss great misfortune to A.E.A., and aeronautics generally.

Mrs. A. Graham Bell.

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To Mrs. G. Bell, Baddeck, N.S.

Washington, D.C., Sept. 18, 1908 :— We were not there, but Uncle Charlie, Cousin Grace, Mr. Lathrop were. Tom's parents coming; funeral on their arrival. Wright improving. German Emperor cabled sympathy to Selfridge's. Have wired Charles. Tom unconscious from first. Real cause of accident still obscure.

David Fairchild.

Letter .

To ? D r. Alexander Graham Bell, President Am. Aerial Experimental Ass., On Train, “Sydney Flier” No. 86, New Glasgow, Nova Scotia.

New Glasgow, N.S., Sept. 18, 1908 :— Feeling as we do after our visit of yesterday to Beinn Bhreagh, a new and special interest in the problem of Aerial Navigation, and your experiments in that direction, and results so far obtained, we desire to convey on behalf of the Nova Scotia and Canadian Press Association our deep sympathy in the loss of your friend and co-worker, Lieutenant Thomas Selfridge, Secretary of your Association whose life was sacrificed yesterday in the cause of aerial science.

At the same time we wish to express our appreciation of your thoughtful courtesy in showing us so much during our short visit.

On behalf of the Nova Scotia, and Canadian Press Associations:—

Fred E. Cox, Member Executor, Nova Scotia Press Ass.

C. M. Young, Member Executor, Canadian Press Ass.

BULLETINS OF THE Aerial Experiment Association

Bulletin No. XII Issued Monday, Sept. 28, 1908

THE ASSOCIATION'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association .

BULLETIN NO. X ISSUED MONDAY SEPTEMBER 28, 1908 .

Beinn Bhreagh, Near Baddeck, Nova Scotia .

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FOREWORD .

The Chairman had arranged that this, the last Bulletin to be issued in the original year of our Association should be a Memorial Number, consisting of photographs recording the work so far accomplished by the Association. The Photographs were to be enlarged, and where no negatives or copies of desired pictures were at hand, these were to be first re-photographed.

In the absence of the Chairman a most loyal and earnest effort was made to carry out his wishes by the photographic staff assisted by Mr. Cox. They worked out of time, and until stopped on Sunday.

Unfortunately owing to the lack of proper facilities for the work and the total inexperience of the operator, it has been found impossible to produce pictures worthy of the Association and satisfactory to the Chairman.

In this emergency the conclusion was reached that it would be better to issue the Bulletin in this fragmentary form so that the weekly record of issue may not be broken. The photographs will now be left for the Chairman's decision, and can be issued later as a supplement.

Too much praise cannot be accorded Mr. Cox for the devotion he has displayed in this crisis. Without his willing and indefatigable co-operation it would have been necessary to have intermitted this weeks Bulletin altogether — an occurence which we feel assured would have been regretted by the Chairman. M. G. B.

2

TO THE ASSOCIATES .

This Bulletin, issued in your absence, must not go without a few words of that which is filling all our hearts at this time.

On Thursday, September 17, the beautiful bond of companionship which we called “The Aerial Experiment Association” was broken, when Tom Selfridge sealed his devotion to our common cause with his life.

To-day in Washington the last military honors are being paid to him, as an officer who died in his country's service, and all over the world true hearts are sorrowing for the brave young life so suddenly cut down in its brilliant beginning,

(Mrs. Grosvenor reports the fishermen in all the little St. Anne's hamlets are talking of nothing else).

They say Tom was happy, absolutely jubilant, and his was a glorious soldier's death, fame and honor are his, His name will be linked with aviation for all time. But — but we who knew him as he was, knew how much of achievement he had to give his country, and the world, how well fitted to live — what a friend, comrade, son and brother, true man and loving heart he was, find it hard to accept even this as best for him.

Others will place on record what Lieutenant Selfridge was as patriotic soldier, earnest worker in the struggle to win for mankind the highway of the air — will tell of his years of preparation and of what he was given opportunity to accomplish — to the Mother of the Association it may be permitted to speak of him as he was in the family.

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When it was proposed to bring this strange young artillery officer into the family, enquiries were made concerning him. Most unfortunately the reply was not kept; but it said, “He is a chivalrous gentleman fond of such society as comes in his way”. We found the report correct.

He was one of the most loveable boys I have ever known, good, true, gentle and affectionate. From the first day when, on my home-coming a year ago, he met me with friendly eyes and welcoming smile, to the last, when he bade us good-bye at the train in Bath, N.Y., he showed me the gentlest, most thoughtful consideration. None more quick than he to see what was wanted for my comfort or pleasure. He always found something to do, a chair to be placed at table, lights to be put right;— little unobtrusive acts of thoughtfulness which, almost unnoticed at the time, were later missed. The same quiet kindliness characterized his bearing to every other woman he came into contact with, so that to-day they cannot speak of him without tears. He so identified hims le el f with everything that we each felt that our interests 4 were also his. He was so quiet it seems strange how large the place is he has left ? v acant. In his favorite khaki flannel shirt and old corduroy trousers, which had seen good service, and running about bareheaded, Tom was so simple and remote from display that at first it comes with almost a shock to think of him in connection with the pomp and circumstance of the military funeral he is receiving. On second thought, however, one realizes that such things meant much to him as part of the profession he loved, and that he was always conscious of his right to them.

Tom had a high sense of responsibility, it showed amusingly in his relation to his young twin brothers, in the little airs of elder brotherliness he assumed, and yet it was most beautiful. His father had left them to his care and their development into good men, morally, mentally and physically was a matter of anxious concern.

He was immensely pleased when they were invited to Beinn Bhreagh, and devoted himself to taking them about showing them 5 everything and trying to improve their minds by making them observe the construction of the Tower, and watch the experiments at the Laboratory. Later we heard of his making trips to their school to pull them out of scraps, or to see they were properly cared for through illness. The same sense of responsibility cropped out every now and then in conversation, about the condition of our military forces, and in the discussion of ways of rendering them more efficient. Ones abiding impression of him was of gentleness and stillness in rest — coupled with a sense of his underlaying strength and immoveable determination. He was full of quiet fun and good humour, and I never saw him out of temper, although he did chafe occasionally at what he thought the Chairman's unnecessary caution in allowing flights. He took in amused good part the being unceremoniously bundled out of his room, as was sometimes unavoidable in unusual press of visitors. He asked nothing for himself; one felt he had long been accustomed to take care of himself, as well as of others, but whenever any little thing was done for his comfort or pleasure he noticed it at once and was pleased and grateful far beyond what was necessary.

One evening, towards the end, I came down stairs to find him waiting at the foot. He had pulled up a big armchair, arranged lamps behind so the light should be right. Placing me in it he knelt beside me and made a little speech undeterred, although somewhat interrupted by injections of “Be quiet boys”, as the others chaffed him. He said he wanted to thank us for all we had done to make him so happy, and especially he wanted us to know how much he appreciated being allowed to be the one 6 to go up in the Cygnet, and how very grateful he was for that honor. Indeed his appreciation of people's kindness to him was unusual and charming. He was outspoken, never fearing to say just what he thought, but he never said unkind things of people — rather he constantly went out of his way to speak kindly of them. Anything he could do to help people he did. He was ready always — for work — or for play. He had a good time when there were parties here or across the water, but seemed perfectly content to sit quietly by the fire with his book or to listen with the slow pleasant smile that was one of his characteristics, while others talked or chaffed. Nothing escaped those bright brown eyes of his. He loved music and frequently set the graphophone going and remained alone in the dark dinning room contently listening. He was genuinely fond of the children and often found his way alone to their nursery.

It was a good time that last year. I think none of us will forget it or cease to be glad of it. We will not forget the early summer fencing on the front veranda when Casey came down from his day's work on the Tower, and Tom and John from the Laboratory, the coming of the Wild Cat, the afternoon teas with the babies beside the big warm fireplace when the Associates came in cold and wet, and there were romps with little Mabel afterwards, the nightly games of billards etc., or the Wednesday evenings of stories and songs, rifle shooting and banquets; or the home-comings after stormy weather on the Gauldrie. It is good to think we had that year all together — that he was happy with us and loved us all even as we loved him.

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And now we are all going forward with our lives — thankful for having known him; thankful for the dear memory he has left us of stainless, noble mankind, and his death will have but cemented the bond between us who are left.

Beinn Bhreagh, September 26, 1908.

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COPIED FROM WASHINGTON POST .

Washington Post Sept. 20, 1908 :— Telegraphic advices received at the War Department yesterday announced that Dr. Alexander Graham Bell, the aeronautical expert, with whom Lieut. Selfridge had been associated, was on his way to this city from Halifax, to attend the funeral. He is expected to arrive here to-day. Dr. Bell sent the following telegram to the father of Lieut. Selfridge on learning of the young man's death:—

“The Aerial Experiment Association wants you to know that your son, Tom, its Secretary, will be missed by the Association and its individual members, as your son is missed from the family circle.

“Alexander Graham Bell. President”.

Dr. Bell, in an interview, paid a tribute to the memory of Lieut. Selfridge, who, he said, was one of the most thorough aeronautical experts in this country. He criticised the construction of the Wright machine, declaring the two propellers should be operated by one shaft, instead of by two, and ? t hat had this form of power trnasmission been used the accident would not have occurred.

Dr. Bell further said that the experiments of the Association, of which he is President, will be continued, and that there will be important tests made at Hammondsport during the middle of October, when flying machines Nos. 5 and 6, now being built on the tetrahedral design will be used in ascents.

Washington Post.

9

TRIBUTE TO LIEUT. SELFRIDGE.

Washington Evening Star, Sept. 21, 1908 :— Tribute was paid to the memory of Lieut. Selfridge at a meeting of the American Aerial Experiment Association held at the residence of Dr. Alexander Graham Bell to-day.

All the remaining members of the Association were present. These included Dr. Bell, the President of the Association; Glenn H. Curtiss, F. W. Baldwin and J.A.D. McCurdy.

Mr. McCurdy was elected Secretary of the Association in place of Lieut. Selfridge. Resolutions of regret were passed touching the death of Lieut. Selfridge. Resolutions of sympathy were drafted to be forwarded to Orville Wright.

The Selfridge resolution said that the Association wished to place on record its high appreciation of its last Secretary, who met his death in his effort to advance the art of aviation. The Association lamented the death of its dear friend and valued associate.

The United States Army, it said, loses a valued and promising officer, and the world an ardent student of aviation, who made himself familiar with the whole progress of the art of the art in the interest of his native country. It was resolved that a committee be appointed by the Chairman to prepare a biography of Lieut. Selfridge to be incorporated into the records of the Association, and that a copy should be transmitted to his parents.

The resolutions to Wright extended to him the deepest sympathy for his grief at the death of their associate, Lieut. Selfridge. The Association said they realized that in this 10 pioneering of the air, the unforseen must sometime occur. They hoped, however, that Wright might soon recover from his severe injury and continue, in conjunction with his brother, Wilbur Wright, his splendid demonstration to the world of the great possibilities of aerial flight.

Luncheon was afterward served to the members of the Association, who were joined by Maj. Squier, the acting Chief Signal Officer.

Washington Evening Star.

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Telegrams from Members .

To Mrs. Alexander G. Bell, Baddeck, N.S.

Washington, Sept. 26, 1908 :— Selfridge at rest. Impressive military funeral yesterday. Selfridge's father present. At Association's meeting decided to continue without change for six months.

Alec.

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Letters .

(Extract from letter to Mrs. Bell by A. G. Bell).

Washington, D.C., Sept. 22, 1908 :— We reached here Sunday afternoon. Monday, Sept. 21, we held a formal meeting of the Association, appointed Douglas McCurdy as Secretary, and passed resolution of appreciation of Selfridge, and resolution of sympathy for Orville Wright, who is lying at the military hospital at Fort Meyer suffering from very serious injuries. Newspaper reporters from a number of papers were on hand to know what the Association was doing.

Major Squier took lunch with us, also Mrs. Fairchild, Curtiss, Baldwin and McCurdy.

Cause of accident. Rudder wire caught in one of the propellers. Wire snapped and propeller broke. Under action of other propeller machine swung round in air. Wright then shut off engine and attempted to glide to ground, but the snapping of the rudder wire rendered the steering gear useless, and the machine began to fall without any means of controlling it excepting the front control. In his excitement Wright evidently raised the front control too much, or too quickly, causing head to rise with danger of sliding backwards, and this caused machine to lose its headway. Under these circumstances all control was lost, the weight of two men and the engine, all at the front part of machine, caused the head to point almost vertically downwards, and the machine dived towards the ground. Under the headway gained by the dive he might have regained control had he been further from the ground, and indeed it appeared that the machine was beginning to right, but there was not 13 room enough for a clearance of the ground. If he had had 15 or 20 feet more space for a drop there is little doubt that the disaster would have been only “an experience” as one of the papers puts it. As it was, the machine struck the ground with the full force of its fall, and all was over.

The fatal catastrophe was undoubtedly due to loss of headway.

Tuesday Sept. 22. This morning went out to Fort Meyer with Baldwin and McCurdy (Mr. Curtiss returned to Hammondsport yesterday and will return for the funeral when date is fixed). Called at the hospital and enquired for Orville Wright, who is too ill to receive visitors. We left our cards for him. He is doing as well as could be expected.

We then went to the building where the remains of the machine are housed and inspected the remains so far as accessible. I was sorry not to be able to see the broken propeller, as the propellers were boxed up ready for shipment to Dayton, Ohio. Sergeant Dowley (?) received us very courtiously and showed us some splendid photographs of the apparatus.

We then went to the Arlington Cemetery to the Receiving Vault where poor Selfridge's remains lie awaiting interment. Then returned to Sergeant Dowley's tent to copy some details concerning various flights made by Orville Wright. Found Mr. Chanute there. He told us that Miss Wright was asleep having been up all night with her brother. Mr. Chanute returned to town with us and took lunch, and spent the whole afternoon with us. At lunch we had David Fairchild, Mr. Chanute, Mr. Baldwin, Mr. McCurdy, Mr. Cloudy (photographer for the N.Y. Herald), Mr. Clime (photographer for the Agricultural 14 Dept) and A. G. B.

Mr. Clowdy and Mr. Clime showed us the photographs they had taken of the flights.

They will supply the A.E.A. with a complete file of their photographs, and the Association will invite the public to send in photographs for preservation, so that the A.E.A. may make a historical exhibit of the historical flights of Orville Wright for permanent preservation. We propose to turn over the whole collection to the National Museum.

A letter has just arrived from the Acting President of the Aero Club appointing me the Chairman of a committee to represent the Aero Club at the funeral of Selfridge. I have thought it best to decline and have sent the following telegram to Mr. Hawley:—

“With your permission I will ask Chanute to act as Chairman of Committee representing Aero-Club at funeral of Selfridge, as I will appear as Chairman of Aerial Experiment Association of which Selfridge was Secretary. Telegraph reply.

A.G.B.

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WORK OF BEINN BHREAGH LABORATORY: by William F. Bedwin, Superintendent.

Tried experiment with Dhonnas Beag for pull and rotation with the double propellers; 6 feet long, 8 foot pitch (approximately). Results:— Rotations 550 in 30 seconds; pull maximum 115; steady at 105. This experiment was repeated twice.

The new double propellers are about ready to mount on the Dhonnas Beag. Following are the measurements of these propellers. Diameter 2.08 meters; pitch 30° at tip. Width of blade 30 cm at tip, and 15 cm at hub. The blades of these propellers are made of laminated wood, double two mm thick, and fastened to skeleton frames with glue and screws, making a very strong and good propeller.

Aerodrome No. 5

Making good progress with aerodrome No. 5; have both faces and all the outside edges beaded. The center section of the quarter sized model of No. 5 aerodrome is finished and ready to insert in model structure. The half-sized center section is also well advanced and we are getting out the metal fastenings for the corners of it.

Good progress is being made with the white model of No. 6 Oionos machine. It is about all assembled and we are starting the beading of it at once.

Just received into stock a lot of fish-section material for No. 6 machine, size 7/16‘‘ 3 to 1.

Have men at work still on spherical connections for the cell sticks of No. 6 machine.

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Washington Post, Sept. 20, 1908 :— (Paris, Sept. 19). The Revue d'Aviation to-day publishes a series of expert opinions concerning the work of various French and foreign aeroplanists. The writers unanimously admit the present superiority of the Wright Brothers, principally on account of the double propellers, but they agree that the Wright machine is too cumbersome and large.

They insist that the machine of the future must, in the first place, leave the ground making use of its own power alone, and second, be automatic l a lly stable, thus permitting any one who can ride a bicycle or drive an automobile to handle it.

Washington Post.